P R E F A C E.

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I N D E X.

INTRODUCTION TO THE THESIS.

There can be no doubt that the Maternal Mortality rate which has remained unchanged for so many years constitutes a very real problem and one which seriously affects the well being of the community. The task of solving this problem has fallen primarily upon the Obstetrician. Large numbers of workers have entered the fields of research which present themselves in connection with puerperal sepsis and the toxaemias of pregnancy. While these conditions are undoubtedly responsible for the majority of fatalities which occur, and while one can hardly underestimate the value of research in these fields, progress will necessarily be slow on account of the very limited knowledge of the subjects in our possession.

It would be unfortunate if in this concentration upon the major factors governing maternal death, the minor causes were overlooked. Cardiac disease complicating pregnancy is one of these latter causes and, according to the Department of Health statistics, ϕ is responsible for 5% of the Maternal deaths. This is by no means an insignificant figure. Moreover the advances made in cardiology in recent years have put us in possession of much knowledge which, if it were properly utilised, would be of inestimable value when applied to pregnancy complicated by heart disease.

MacKenzie in 1921 made an effort to secure a closer liaison between obstetrician and cardiologist. Unfortunately the improvement which resulted was in no way commensurate with the effort which he made, indeed the very obstetric text books which he condemned on the grounds of insufficiency have not altered materially in character since his publication.

ϕ Departmental Report (Interim) Maternal Mortality and Morbidity 1930.

It must be admitted, however, that although diagnosis and more particularly prognosis in pregnancy complicated by cardiac disease were adequately dealt with by MacKenzie, his references to treatment do not meet fully the needs of present day obstetric practice. Many new forms of treatment have become popular. Caesarean Section has been perfected. The various forms of anaesthesia, nitrous oxide and oxygen, ethylene and oxygen and, spinal and local anaesthesias have modified surgical treatment. Medical treatment has been influenced by the more general understanding of the actions of digitalis and strophanthin, and by the popularisation of scopolamine and morphine narcosis and other therapeutic measures.

It is my contention that recent advances in medical and surgical technique have never been properly applied to heart disease in pregnancy and that, until there is a closer correlation between the physician and the obstetrician in regard to the treatment, no improvement will be made in the mortality rate arising from this condition.

The care of the pregnant woman who is also the subject of cardiac disease involves innumerable difficulties. In some cases there is merely an association of the physiological state of pregnancy with a pathological cardiac state. The question of the effect of the one upon the other immediately arises. Again while normal pregnancy is physiological, it may on occasion become pathological by the onset of any of the toxic states peculiar to pregnancy or by the existence of any abnormal feature such as a bony deformity in the mother, placenta praevia, hydramnios, or similar complication. Apart from the purely obstetrical aspects which present themselves there are often social, marital and religious questions which are obstacles to the physician in charge. These difficulties where they have been understood have often led obstetricians into unnecessary termination of a pregnancy as being a safe way out of a difficulty, and where the difficulties have not been understood they have frequently led to more serious results.

To those interested in cardiac disease in pregnancy it is striking how little work has been done by obstetricians upon the subject. Angus MacDonald in 1878 laid the foundations of the British interest. No work of note is in the records until forty years later when he was followed by Sir James MacKenzie whose book "Heart Disease and Pregnancy" is among the medical classics. Thereafter further contributions were made by Lennie and Munro Kerr in Scotland and by Hunt and Robinson in England. More recently still Dame Louise McIlroy has founded a cardiological clinic at the Antenatal Department of The Royal Free Hospital.

On the continent similarly the work has been carried on by an isolated few whose observations are, however, of exceptional interest. Dreysel, Fellner, Von Jaschke and Gammeltoft are possibly the most outstanding, and to the last named and his co-workers, we owe our present knowledge of the physiological reactions of the heart in pregnancy.

The American school has not contributed much that is new although Breed White, Pardee, DeLee and Reid are amongst modern authorities upon the subject.

These are the writers upon whose work most of our practice is based. I shall make further reference to them in the text. It is with the intention of amplifying this work and adding to it the results of my observations that I have undertaken this study of pregnancy, parturition and puerperium when complicated by a pathological cardiac state.

OBJECT AND SCOPE OF THE THESIS.

The object of the thesis is to attempt to reduce the Maternal Mortality from cardiac disease in pregnancy by a detailed study of the condition in its various aspects.

As a principal basis of study I have personally examined 113 consecutive cases of cardiac disease in pregnancy. They have been observed antenatally in labour and in the puerperium and in some cases several months after their confinement.

For the sake of comparison and in order to appreciate the attitude of the obstetricians at the time, I have examined the Hospital records of twenty, fifteen and ten years ago. The analysis of these early cases is set forth in the first section.

The second section contains a detailed consideration of present-day cases and reference is made to current opinion. In addition suggestions are made regarding more adequate classification and more efficacious treatment.

SECTION I.

The cases which come under review in this section were collected from the entire records of the Glasgow Royal Maternity and Womens Hospital. Statistics for three separate years were selected in order to obtain a representative idea of the views held by obstetricians at that time.

The first year selected was the year commencing 1st August, 1909, and ending 31st July, 1910. In that year there were 1,533 patients admitted to hospital. By a careful scrutiny of the case reports, histories, symptoms, and examination findings of each case 56 were found to be suffering from cardiac disease, thus pregnancy complicated by cardiac disease had an incidence of 3.6% in that year. Between 1st February, 1914, and 31st January, 1915, 1,525 patients were admitted. Of these only 31 had a cardiac affection giving an incidence of 2.03%. The year commencing 1st February, 1920, ending 31st January, 1921, was also examined and it was found that the number of patients admitted had almost doubled, the actual figure being 3,288. This increase can be explained partially by an increase in the size of the hospital and partially by a rise in the birth rate corresponding to the demobilisation of the fighting armies. It is interesting to note, however, that the number of patients with cardiac disease was 52 giving an incidence of 1.31%. Comparing pre-war figures with post-war shows that although the general admissions to hospital in the latter year had doubled there was no increase in the actual number of patients with cardiac disease admitted. In fact the figures 56 and 52 are strikingly similar.

In making a survey of the cases which occurred during these three years it was found that no marked alteration of attitude towards the condition was evident from first to last. It was, therefore, thought to be an advantage to group these three years and study them as a whole rather than as three separate entities, the differentiation between which would have been entirely arbitrary.

CLASSIFICATION:

It would seem that in early years no great importance was attached to classification. Many cases were classed as "Cardiacs" with no mention of the lesion or its extent. Others were classed as "Mitral Disease" and occasionally "Cardiac insufficiency". Some cases carried the label "Cardio-renal". These were usually patients who had symptoms of Albuminuria of pregnancy in conjunction with a cardiac murmur. Often the blood pressure was not noted nor the state of the arteries mentioned, and one was led to conclude from the case report that the classification had been somewhat loosely applied. On the whole, however, the patients were classified according to the valvular lesion present as diagnosed by physical examination and occasionally verified at post-mortem. Reference to the state of the cardiac reserve or compensation was notably absent. This has been commented upon by others, particularly MacKenzie (1) and Von Jaschke (2). It is possible that their influence, along with the general trend of cardiological opinion, has led to the more modified views on anatomical valvular lesions per se which exist to-day.

In discussing the various aspects of the condition at that time it will be necessary to adhere to the classification then adopted. There is insufficient data for any other classification and, moreover, that which has existed has a bearing upon the results which were obtained. I have, therefore, tabulated below the cases as they were classified during the period under review:-

TABLE I.

CLASSIFICATION.	1910.	1914.	1920.	Total & %.
Mitral Stenosis	22	9	15	46 33.09%
Mitral Incompetence	20	13	16	49 35.25%
Combined Mitral stenosis & Incompetence.	1	4	5	10 7.19%
Aortic incompetence	1	1	-	2 1.44%
Combined mitral stenosis & aortic incompetence.	1	-	-	1 .72%
Combined mitral incompetence & aortic incompetence	3	-	3	6 4.32%
Mitral incompetence & acute endocarditis.	-	-	1	1 .72%
Myocarditis	1	1	4	6 4.32%
Auricular Fibrillation	1	-	3	4 2.88%
Myocarditis & ? Auricular fibrillation	-	-	1	1 .72%
Tachycardia	-	-	1	1 .72%
Cardiorenal	5	3	3	11 7.9%
Unclassified	1	-	-	1 .72%
TOTAL	56	31	52	139

Fellner, Porak, Vinay, Pardee and DeLee together collected 268 cases of cardiac disease complicating pregnancy, and as they are similarly classified they provide an interesting comparison with the above

TABLE II.

CLASSIFICATION.	NUMBERS.	%
Mitral Incompetence	74	27.6%
Mitral Stenosis.	50	18.7%
Combined Mitral stenosis & Mitral incompetence	76	28.3%
Aortic regurgitation	20	7.5%
Aortic Stenosis	2	.8%
Combined Mitral & aortic lesion	41	15.3%
Myocarditis	5	1.8%
TOTAL	268	-

The outstanding differences between the two statistical surveys are seen in the "double Mitral" lesion which constitutes 7.2% of table I and 28.3% of table II. Also aortic incompetence in table I which is 1.4% as against aortic regurgitation in table II which constitutes 7.5%. No mention is made, however, as to whether these latter aortic lesions were of rheumatic origin or not. According to MacKenzie (1) the pure aortic regurgitation of non-rheumatic origin is rarely met with in pregnancy. He quotes only two cases in his personal knowledge. Lennie (3) and Robinson (4) each quote one case. Their observations are more in accordance with the figures in table I than in table II (the American Series).

Mitral Stenosis on the other hand would appear to be commoner in this country than abroad being 33.09% as against 18.7%. This is of interest as Mitral Stenosis is generally recognised to be the most serious valvular lesion in pregnancy and, according to Von Jaschke (5) "is exceptional in that its compensatory mechanism is unfavourable".

The wide divergences between the American figures and my own are, in my opinion, an excellent indication of the unsuitability of the anatomical classification which was adopted at that time. The functional classification adopted in the second section of the Thesis affords a much more accurate basis of comparison.

DIAGNOSIS.

The cases which are at present under review would appear to have been diagnosed as cardiac disease complicating pregnancy chiefly by the aid of the stethoscope. As might be expected murmurs arising from valvular lesions seemed to have been regarded as pathognomonic of cardiac disability. In the year 1910 the examination of a patient suffering from cardiac disease in pregnancy, more attention seems to have been paid to the measurements of the pelvis and to the presentation and position of the foetus, than to the history and symptoms of the disease from which the patient suffered. Physical examination of the heart by inspection, palpation, percussion and auscultation seem to have been the primary diagnostic factors. Rarely do the records show an inquiry into the patient's cardiac condition during previous pregnancies. Her cardiac condition, and the degree of compensation present in the non-pregnant state, was practically never mentioned. As regards the symptoms of cardiac breakdown which manifested themselves in the pregnancy under treatment, these were but briefly noted.

In the year 1914-15 there was obviously an improvement in the character of the records. Past histories were more numerous and present symptoms were more detailed. More stress seemed to be laid upon the etiological factor of rheumatic fever. Still the valvular lesions seemed to be regarded as of paramount importance, and still the relationship between the cardiac state in the pregnant and non-pregnant seems to have been not considered worthy of mention, or overlooked altogether.

In 1920-21 the position had changed little from that of five years previously. Diagnosis was still based upon a brief history accompanied by a cardiac murmur. No definite attempt at estimation of the severity of the lesion or the existing state of cardiac reserve was evidenced.

In this observation I am borne out by MacKenzie (1) who stated in 1921 that "the obstetric physician, if we may judge from modern text books, has never taken the trouble to understand the elements of cardiology in consequence he still pursues his enigmatical methods etc."

While a certain amount of just criticism can be levelled at the obstetricians of those times on the grounds of failing to make the fullest use of the cardiological advances of their day, one must give them due credit for realising the gravity of the mitral stenosis lesion complicating pregnancy. Von Jaschke's dictum upon this subject has already been quoted. Although by their diagnostic methods they may have lost many valuable aids to the patient's cardiological prognosis their methods were adequate for the diagnosis of mitral stenosis, thus singling out the cases which were most likely to cause trouble during pregnancy.

Mitral stenosis was usually diagnosed by the presence of a late diastolic or presystolic murmur at the apex, while mitral incompetence rested upon the presence of an apical or basal ventricular systolic murmur. The quality of the cardiac sounds was rarely mentioned and the diagnosis of myocarditis appears to have been made when undoubted cardiac symptoms were displayed and there were no murmurs present to explain their origin. A combination of a few renal symptoms together with a cardiac lesion, was sufficient ground for the diagnosis of the "cardiorenal" case.

From the records at our disposal it would seem that diagnosis went no further than this.

ETIOLOGY.

The etiological factors of cardiac disease are now recognised to be of some importance in regard to pregnancy and childbirth. The incompetent heart due to long antecedent rheumatic infection, or to a recent exacerbation of such an infection, is likely to prove more serious than the incompetent heart which is secondary to a condition of anaemia or debility. The latter being usually amenable to appropriate medical treatment.

I have found in my present-day cases, which are dealt with later, that extrinsic factors such as anaemia, debility, pulmonary disorders and toxaemias play an important part in bringing about a relative cardiac insufficiency. As a result of study of the earlier cases one cannot state with any degree of certainty the numbers in which the heart was thus affected. Macdonald's (8) view that "time after time those parturient patients with chronic disease of the heart express themselves as unaware of ever having had rheumatic fever" is amply borne out in the earlier cases.

ETIOLOGY CONT.

The following table will show the etiological factor to which the cardiac lesion was attributed, as noted in the records:-

TABLE III.

ETIOLOGICAL FACTOR.		1910	1915	1920.
Rheumatic Diathesis.	Rheumatic Fever	18	11	24
	Chorea	4	-	1
	Scarlatina	6	-	1
	Bronchitis & Emphysema	4	1	2
	Diphtheria	-	-	1
	Syphilis	1	-	1
	Arteriosclerosis & Renal disease.	6	3	2
	Enteric fever	1	-	-
	Puerperal fever	1	2	1
	No attributable cause.	15	14	20
	TOTAL	56	31	52

The number of patients who manifest the rheumatic diathesis which would account for cardiac involvement is strikingly low, namely 65 patients or 56.7%. Rheumatic infection it will be seen later is responsible for a larger proportion of the present-day lesions, and this is probably due to the acceptance of "growing pains", repeated "sore throats" etc., as being indicative of the acute rheumatic diathesis. It is probable that a number of the cases classified above as having no known attributable cause were due to some mild rheumatic manifestation which was not considered worthy of note or to anaemia. With regard to the latter condition, Carey Coombs (11) has observed that out of 36 patients suffering from severe anaemia ten were first diagnosed as "cardiac disease" which observation corresponds with my own clinical experience, namely, that many patients are sent into Hospital as cases of cardiac disease which in reality are anaemias of pregnancy. Occasionally at post-mortem examination a so-called "cardiac" patient is found to have no obvious myocardial or valvular lesion, and one is led to wonder how often the cardiac symptoms presented in pregnancy are merely an obvious manifestation of some more obscure pathological state.

Compensation & Prognosis.

That compensation or the state of the cardiac reserve is the primary factor governing prognosis in heart disease is now almost universally recognised.

Compensation & Prognosis, cont.

In pregnancy occurring in a patient with heart disease, the state of the cardiac reserve similarly influences the prognosis for the pregnancy, puerperium and future well-being of the patient. This was appreciated to some extent by the earlier continental obstetricians thus Spiegelberg (6) stated in relation to labour pains and cardiac disease, "the degree of compensation of the cardiac lesion being under ordinary circumstances enough to make the situation tolerable is no longer sufficient for the altered and especially the suddenly altered relations of pressure". The attention of the continental workers was more directed towards the existence or not of a physiological hypertrophy of the myocardium in pregnancy than to the clinical results of such hypertrophy. Larcher (7) in as early as 1859 examined at post-mortem the hearts of 130 women who died from puerperal fever and concluded that "the heart in the human species is normally enlarged during the period of gestation, that enlargment affects almost exclusively the left ventricle". This finding was hotly disputed by many workers, more particularly Gerhardt & Lohlein who contended that dilatation occurred and not hypertrophy. Larcher's work was to some extent confirmed by Dreysel (8) in 1891 who weighed the hearts at post-mortem of 76 women who had died in the puerperium and found them to weigh 8.8% more than the hearts of the non-pregnant.

In 1878 McDonald (9) produced the only British work of note upon the subject. McDonald stated from his observation that there existed "a certain physiological degree of increase in the capacity of the left ventricle with a variable amount of muscular hypertrophy". This careful observation of over fifty years ago expresses the view which is held to-day and which has been proved and to some extent amplified by Gammeltoft (10) and his co-workers by means of a large series of electrocardiograms, radiograms and rather complicated physiological experiments, e.g. the "Minute cardiac volume" experiments of Norgaard.

Length of Stay of Patients in Hospital.

The length of time a patient with cardiac disease spent in the Antenatal Wards of the Hospital gives a rough indication of consideration which was paid to her condition before labour.

Length of Stay of Patients in Hospital, cont.

In addition, the length of stay in the lying-in wards of the hospital, provides some evidence of the seriousness of the condition which prevented her from being dismissed upon the 10th day as would occur in normal uncomplicated cases. With this idea in view, I have extracted from the records the length of stay of patients, both antenatally and post-natally, and tabulated them. The results are given below:-

TABLE IV.
ANTENATAL HOSPITAL CARE.

Duration of Treatment.	No. of patients treated in 1910.	No. of patients treated in 1915.	No. of patients treated in 1920.
Under one week.	7	9	17
Over one week, under two weeks.	2	1	9
" two weeks, " three "	2	-	9
" three " " four "	1	2	3
" four " " five "	-	-	1
" five " " six "	-	-	-
" six "	-	-	1
TOTAL.	12	12	40

TABLE V.
POST-NATAL HOSPITAL CARE.

Duration of Treatment.	No. of patients treated in 1910.	No. of patients treated in 1915.	No. of patients treated in 1920.
1-10 days	32	9	17
10-14 days	12	6	11
14-21 days	2	1	5
Over 21 days	4	6	3
Undelivered, Irregular dismissals, died, etc.	6	9	16
TOTAL.	56	31	52

From the above table (IV) it will be seen that in 1910 only 12 of the 56 or 26% patients with cardiac disease received any antenatal care at all. The remaining 40 were admitted in labour. Of the 12 who received antenatal care only 5 received it for a longer period than one week, in most instances the patients were only in for a day or two before labour.

In 1915 there is a slightly higher proportion found. Twelve of the 31, or 39% patients received antenatal care, but only 3 for a longer period than one week.

In 1920, however, a very different result is obtained, 40 or 77% out of 52 received antenatal care. Of these 40, 14 received over a fortnight's antenatal care.

One is justified in presuming that the incidence of severe cardiac disease in pregnancy would be approximately the same in 1910 as in 1920. The marked increase in the numbers of cardiac patients receiving antenatal care in the latter year as compared with the former (26% as against 77%) would seem to indicate that the condition was receiving more serious attention from the obstetricians and that an attempt to secure adequate antenatal treatment was made in 1920 which was not apparent a decade earlier. It is impossible to ascertain from the records what actually brought about this improvement in the treatment of patients with cardiac disease. It may be that the benefits of antenatal care of the pregnant woman in all complications of pregnancy were becoming more generally appreciated and that the patient with cardiac disease gained along with the rest. Or it is possible that the obstetricians of the day were appreciating the gravity of the condition per se. In either case it is worthy of note that an improvement in the treatment of the condition had commenced before Sir James MacKenzie drew attention to the deficiences in treatment in his publication of 1921.

Table (V) shows the length of stay in the Lying-in Wards of the Hospital. In 1910, 32 patients or 56% were dismissed within the normal ten days lying-in period. The remaining 44% were treated for longer periods.

In comparison, in 1920 17 patients or 30% within the normal ten days, whereas 70% remained for an extended lying-in period. Thus it will be noticed that in addition to greater antenatal care the patients with cardiac disease received more post-natal attention in 1920 than in 1910 and it seems reasonable to conclude, therefore, that the condition was coming to be regarded as a more serious complication of pregnancy than in former years.

TREATMENT.

The question of the treatment administered to the pregnant woman with cardiac disease will be considered from two aspects, the medical or conservative, and the surgical or radical.

TREATMENT CONT.

Mention has already been made to the amount of antenatal care which patients with cardiac disease received in former years. In 1910 and 1915 the numbers who received any prenatal hospital treatment was exceedingly small (see pages). It is, therefore, obvious that little can be said about the medical treatment the patients received in these years, as any they may have had was administered by their private doctors in their own homes. Reference to the Mortality Table (page 7) will show that a large proportion of the fatalities occurred in patients who were sent into Hospital desperately ill and who died shortly after admission undelivered. This would suggest that the outside medical treatment at that time fell short of the ideal.

It is chiefly from the records of 1920 where 77% of the patients suffering from cardiac disease received antenatal hospital care that the information regarding the medical treatment must be sought. Rest in bed and regulation of the diet, then as now, formed the basis of treatment. Comparatively few patients received more than a fortnight's prenatal care and in one instance only did a patient receive more than five weeks' treatment. The value of prolonged rest is now more generally recognised and in this respect the present-day cases are more adequately treated. As regards the administration of drugs, digitalis and digitalin, strychnine and alcoholic stimulants, found favour. In a few isolated cases strophanthus was given. Digitalis was given in the tincture form and the dose never exceeded 15 minims four hourly. The usual dose was 7 minims thrice daily. When a patient with a damaged heart went into labour it would appear to have been almost routine treatment to administer 1/100 gr. of digitalin combined with 1/30 gr. of strychnine. Many cases received no other preparation other than this last form.

Most cases received no cardiac tonics or stimulants of any kind. From the examination of the records it is difficult to ascertain why certain patients received no medicinal treatment and why others were given cardiac stimulants. The striking feature concerning the treatment is an entire lack of uniformity. This is probably due to the method of classification then in vogue. When cardiac disease is classified from the anatomical lesion present as it then was, rather than from the degree of functional

TREATMENT CONT.

disability, the more modern method, it almost inevitably leads to errors in treatment. There is no doubt that patients diagnosed as having mitral stenosis were regarded seriously and treatment was generally instituted without reference to the state of the cardiac reserve. As an instance of this, Whitridge Williams quotes Lusk (12) as regarding the lesion so serious, as to warrant the induction of abortion as soon as the diagnosis of mitral stenosis is made. No such extreme view was held by those in charge of the cases under review. Mitral stenosis was, however, singled out for vigorous treatment and it is noticeable that many cases of mitral incompetence or other cardiac conditions often received little or no treatment when judging from the symptoms presented they possessed not an insignificant degree of loss of cardiac reserve. These anomalies may be attributed to the mode of classification although Sir James MacKenzie offered more serious criticism to which reference has already been made.

Turning to the surgical treatment of the condition, the outstanding feature is the entire absence of abdominal section as a method of termination of pregnancy. In the 139 cases over the three years there were only two Caesarean sections and these were performed on account of contracted pelvis and not on account of the cardiac state. The operation of abdominal hysterotomy or miniature Caesarean section was never performed.

When it was deemed necessary to terminate the pregnancy before term this was invariably done by surgical induction of labour by means of Krauses Bougies or occasionally Champetier de Ribes Bag. Deliveries were often hastened by means of application of forceps in order to spare the patient the strain of the expulsive efforts of the second stage of labour, a procedure which is still adopted with wisdom.

The question of surgical induction was a vexed one. Jardine (13) in 1899, wrote "the results from induction are so bad that I am inclined to question the propriety of doing the operation; the risk is exceedingly great". In contra distinction Fellner (14) in 1902, advocated "insertion of a bougie at the 28th week" as "the method of choice"

TREATMENT CONT.

Reference to the accompanying table will show that surgical induction was embarked upon in 13 cases and further reference to the mortality table will show that the operation was followed in two instances by a fatal issue. The obvious criticisms to which the operation is open are that (a) the method is a slow one (bougies may need to be removed and re-inserted) and (b) after insertion of bougies the strain of delivery still remains. Gibberd (15) in discussing the average length of time elapsing between insertion of a bougie and birth of the child (in a large variety of cases not restricted to cardiac disease), records it as being 36 hours. In the 13 cases already mentioned the average duration was 27 hours, the shortest being 3 hours, and the longest 76 hours. The foetal mortality as might be expected was high (77%). Apart from the tardiness of the procedure and the strain imposed upon the Mother there are, of course, the usual obstetric risks involved in this method of induction which are not peculiar to cardiac disease, namely sepsis, and separation of the placenta. On theoretical grounds, therefore, if not also upon practical, the operation does not compare favourably with the more speedy and certain method of abdominal section to which further reference will be made.

In one case embryotomy at four months was carried out successfully, and in one case a hydatidiform mole was removed and death resulted on the following day. Although laminarial tents and metal dilaters were frequently used in terminating cases of hyperemesis gravidarum in the early months, this method was not adopted to any extent for cardiac disease. The only cases in this series which terminated in the early months were those in which abortion occurred spontaneously.

Undernoted are the means by which delivery was effected:-

Spontaneous delivery at term	42	65
" " prematurely	23	
Forceps " at term	18	19
" " prematurely	1	
Surgical induction of premature labour	13	13
Caesarean Section (for contracted pelvis).		2
Version & Manual extraction		4
Embryotomy at 4 months		1
Hydatidiform Mole		1
Spontaneous complete abortion		10
Undelivered		24
TOTAL		139

Of the 115 cases in which pregnancy terminated (a) in abortion, (b) in the later months or (c) at term, 65 were spontaneous births giving a percentage of 56.5. 35.5% of these normal deliveries were the result of premature labours. The incidence of prematurity in cardiac disease is generally admitted to be high. There is, however, marked variation in opinion as to the actual prematurity rate. The question is of considerable prognostic importance as the birth of a small premature infant seldom distresses the patient to the same extent as does a full term delivery. French and Hicks (16) place the figure as low as 5.5%. Von Jaschke (17) at 8.9%. Fellner (18) at 20.2%. DeLee (19) in a general survey of the literature places it between 20% and 40% while MacKenzie (1) states as regards mitral stenosis "in nearly all my cases who carried on to the latter months premature labour set in spontaneously". It will be seen that my figure for the earlier cases of 35.5% corresponds to the higher estimates and this fact, together with the figures of the present-day cases, has to some extent influenced my views on the ideal treatment of the cardiac case set out in the succeeding section.

In dealing with the fatalities amongst these cases of cardiac disease complicating pregnancy some interesting features present themselves. A detailed table (No.VI) is given below:-

TABLE VI.
DEATHS FROM CARDIAC DISEASE IN HOSPITAL IN THE YEAR 1910.

Age.	Gravida.	Maturity.	Lesion	Stay in Hospital.	Delivered.	Remarks.
26	P.	8 Mths.	?	1 day.	Undelivered.	Admitted moribund.
28	P.	7 "	Mitral stenosis.	1 "	Undelivered.	Diagnosed 2 months before admission. Admitted moribund.
32	M (2)	7 "	Mitral Stenosis.	A.N. 19 days.	Spontaneous.	Cardiac failure with first pregnancy.
33	M (6)	7 "	Myocarditis.	A.N. 5. P.P. 2 days.	Spontaneous.	6 weeks ill before admission.
26	M (2)	5 "	Mitral stenosis.	A.N. 15 days.	Miscarriage.	Cerebral embolus after 1st child. admitted unconscious.

TABLE VI CONT.

DEATHS FROM CARDIAC DISEASE IN HOSPITAL
IN THE YEAR 1915.

Age.	Gravida.	Maturity.	Lesion.	Stay in Hospital.	Delivered.	Remarks.
22	M (2)	7 Mths.	Mitral stenosis.	1 day.	Undelivered.	Admitted moribund.
31	P	F.T.	Mitral stenosis.	A.N.2 days.	Undelivered.	3 Months ill before admission.
26	M (5)	7 Mths.	Mitral incompetence.	A.N.4 P.P.1	Spontaneous.	Induction advised but refused.
29	M (4)	7 Mths.	Mitral stenosis.	A.N.1 P.P.2	Spontaneous.	-
37	P	8 Mths	Mitral stenosis.	A.N.24 days.	Forceps.	Elderly primipara. 18 hours labour.
18	P.	4 Mths.	Myocarditis.	2 days.	Digital Curettage.	Hydatidiform mole. P.M. Myocarditis.

DEATHS FROM CARDIAC DISEASE IN HOSPITAL
IN THE YEAR 1920.

Age.	Gravida.	Maturity.	Lesion.	Stay in Hospital.	Delivered.	Remarks.
23	P.	F.T.	Tachycardia.	1 day.	Undelivered.	Admitted moribund.
30	M (2)	F.T.	Myocarditis.	A.N.2 days.	Undelivered.	-
32	P	6 Mths.	Mitral incompetence.	A.N.3 days.	Undelivered.	Recent rheumatic fever.
23	M (3)	8 Mths.	Myocarditis.	1 day.	Undelivered.	Admitted moribund.
35	M (5)	6 Mths.	Myocarditis.	A.N.2 days.	Undelivered.	Chronic bronchitis & Emphysema.
38	M (11)	8 Mths.	Auricular Fibrillation.	A.N.3 days.	Spontaneous.	2 Months ill before admission.
27	M (3)	6 Mths.	Mitral incompetence.	A.N.23 days.	Surgical Induction.	Acute endocarditis.
30	M (7)	8 Mths.	Mitral stenosis.	A.N.84 days.	Surgical Induction & Forceps.	-
20	P.	F.T.	Mitral stenosis.	A.N.21 days.	Forceps.	Died 4th day of puerperium suddenly.

TABLE VII.

Year	No. of Patients.	Fatalities.	Hospital Mortality Rate.
1910	56	5	9%
1915	31	6	19.4%
1920	52	9	17.3%
TOTAL	139	20	14.5%

The figures in Table VII are not "corrected statistics" and refer only to the Hospital cases enumerated above. They serve, however, as a basis for comparison with my own succeeding figures and with the figures of the majority of other Hospitals whose statistics are similarly composed.

Generally the mortality rate is high, the striking feature is that of the twenty patients who died, nine died undelivered. This was in part due to lack of adequate prenatal care but is also due in my opinion to a variety of other factors which will be taken up in detail in the succeeding section.

Eight of the deaths occurred in primipara and twelve in multipara giving a mortality rate of 21.5% for the former and 11.0% for the latter, both figures are high.

SECTION I.

Summary of the investigation of the Records of 139 patients with Cardiac Disease complicating Pregnancy occurring in the years, 1910, 1915 and 1920.

(1) The classification of the cases was not considered of importance and was anatomical.

(2) From the records it appears that cardiac reserve as evidenced by past history response to effort was considered of secondary importance to the physical examination of the heart and the detection of cardiac murmurs et sequor diagnosis and prognosis were uncertain.

(3) The incidence of rheumatic fever as an etiological factor was surprisingly low.

(4) The shortness of the stay in hospital of patients with cardiac disease indicates that the gravity of the condition was not fully appreciated.

(5) There was a notable lack of uniformity in medical treatment.

(6) Surgical treatment, when employed, was confined almost entirely to the induction of premature labour by means of bougies, the wisdom of this procedure being open to question.

(7) The general incidence of prematurity was high (35.5%).

(8) The mortality rate throughout the series both in the primigravida and the multipara was high, considerably in excess of present-day figures.

SECTION II.

The first question which confronts the woman with a damaged heart is the advisibility of marriage, and upon this point the advice of the obstetric physician is occasionally sought. Macdonald stated in relation to the problem that "chronic heart disease ought to be looked upon as a grave contra-indication of marriage". The weight of modern opinion is against this dictum. Reid (20) points out that statistics show that the average age at death was 42.4 years for married women with heart disease and 47.2 years for those who were unmarried. He goes on to say that married women with rheumatic heart disease die before their time because of the natural evolution of this disease rather than because of child-bearing. In order to be able to agree with this finding it would be necessary to follow up, until death, the patients with cardiac disease who have borne children and compare them with those who have not. Such an investigation would, of necessity, stretch over a long period of years and is outwith the scope of the thesis. The contention, however, of so reputable a worker is worthy of note. Hone (21) also an American aptly expresses the opinion, with which I entirely agree, that a decision for or against marriage should be based upon effort tolerance, the presence or absence of symptoms, evidence of recent progress of the disease and the economic aspect. The final decision should be made by the patient when the position has been explained to her. The economic aspect of marriage is an important one and where it will result in a lessening of the woman's physical work it is obviously an advantage. Louise McIlroy (22) has summed up the situation when she says that "marriage may improve the patient's physical and social condition and should be permitted where possible".

Over the question of the advisibility of pregnancy in a woman with a cardiac lesion considerable controversy exists. Cowan and Ritchie (23) are only stating the truth when they say "pregnancy in our experience is always a dangerous experiment in women who are subjects of chronic valvular disease. Failure often occurs in the later months, or following childbirth during lactation, though curiously enough it does not seem to be particularly related to accouchement".

To-day the general lack of appreciation of the difficulties of the condition render it "a dangerous experiment". As these difficulties and a proper knowledge of how to treat them becomes more generally understood, the experiment will become less dangerous. Already the Royal Free Hospital shows a markedly lower mortality rate than elsewhere due in no small measure to the establishment of a cardiological clinic in connection with the obstetric unit.

Much more extreme are the views recently expressed by East and Bain (24) (the authors of "Recent Advances in Cardiology") who make the broad statement "all writers agree that no woman who presents any of the signs of cardiac failure or gives a history of past failure should become pregnant". With this I cannot agree. Many of my cases gave a definite history of "past heart failure" and yet survived their pregnancy with little or no discomfort. Full compensation had been established.

Another view expressed by Murray (25) indicates a common attitude "every case", he says, "must be considered upon its merits and such extraneous consideration as the wish for an heir must have no influence".

In not a few cases the woman's desire for an heir is a very strong one and in such an instance it must have some influence upon the treatment advised by her physician. Haig Ferguson (26) has referred to such a case which arose in his own private practice where a patient had a severe cardiac lesion and expressed strongly the desire for an heir. He states he was influenced by this wish and thereafter attended the patient throughout five pregnancies, the fifth producing the desired heir. The patient recovered on each occasion and was not obviously the worse of her experience.

The wish for an heir is not an uncommon one and where the obstetrician and cardiologist combine to put into practice the recent advances in both sciences there should be very few patients with cardiac disease who are incapable of at least one pregnancy with a reasonable degree of safety.

The physiology of the heart in normal pregnancy has recently been worked out in considerable detail and, while much yet remains unknown, the position to-day is much improved from that of ten or twenty years ago. The cases which were reviewed in the first section of this thesis were treated without any exact knowledge of the behaviour of the

heart in normal pregnancy. It was known as a result of the work of Larcher, Dreysel and others that hypertrophy or dilatation occurred and allusion has already been made to this, but beyond that, knowledge did not exist. To-day the obstetric physician is in a stronger position and it is reasonable to suppose that his treatment, therefore, will be more on scientific than empirical grounds.

To Gammeltoft (10) and his co-workers Jensen, Norgaard and Lindhard we owe most of our present knowledge. By a series of electrocardiograms carried out systematically in 32 patients without cardiac disease they made the following observation:- "During the first six months of pregnancy the left ventricle undergoes a relative hypertrophy in proportion to the right ventricle and from the sixth month to parturition this hypertrophy is compensated by a hypertrophy of the right half of the heart; there is, perhaps, also a slight dilatation of the right atrium. The electrocardiographic changes can be demonstrated as early as in the 3rd or 4th month when the change in position of the heart can be of no importance".

The change in position of the heart referred to is the rotation which occurs when the enlarging uterus presses upwards on the diaphragm. This rotation has been demonstrated frequently by means of x-ray photographs and is thought to be of no great significance.

The studies of Prof. Lindhard and Gammeltoft went to show conclusively that the work of the heart was increased in pregnancy. Their experiments were made on the analysis of alveolar air (using a spirometer) and proved that the increase in the blood volume in pregnancy involved an increase in the heart's action. Their experiments were highly technical and were made first upon animals and latterly upon pregnant medical women who were able to collaborate in the investigation.

It is of extreme importance to realise that although the heart is forced to work harder in pregnancy there is a compensatory mechanism at work which enables it to overtake its work without strain. Earlier workers headed by Sir James MacKenzie did not hold this opinion and MacKenzie stated "The assumption that the heart hypertrophies during pregnancy is not justified. All this additional work is met by a call upon the reserve force".

This statement was made, however, several years before the Scandinavian experiments had been published. If the latter contention were correct then the prognosis in pregnancy, complicated by cardiac disease would be more unfavourable than it actually is, for additional calls would be made upon an already impaired cardiac reserve. On the other hand if the work of Gammeltoft is accepted, then the prognosis becomes more favourable and pregnancy will be regarded as a physiological complication rather than a pathological complication of cardiac disease. This, in my opinion, is the correct view to hold provided that one recognises the possibility of pregnancy becoming pathological when complications peculiar to the pregnant state e.g. toxaemias arise.

My view regarding cardiac disease complicating pregnancy is that where the patient has established a cardiac reserve or efficiency which will enable her to carry out her every-day duties she need not fear a normal pregnancy. It will not burden her to the extent generally supposed. It is, however, essential that she have adequate antenatal care and skilled treatment in labour lest any abnormality arise which might upset the delicate physiological balance. If, on the other hand, pregnancy occurs in a patient with cardiac disease, who has not established a reasonable degree of cardiac efficiency, the position is entirely altered. Pregnancy under these circumstances is dangerous from its onset. The most difficult question for the physician to answer is "Has the patient under consideration a reasonable degree of cardiac efficiency"? In most cases the obstetrician sees the patient for the first time when she is already pregnant and the estimation of her cardiac condition prior to pregnancy becomes an extremely difficult task, and may depend almost entirely on the history elicited from the patient herself.

Flack and Woolham (29) by means of spirometric and pulse rate tests have been able to produce a physiological efficiency index for schoolboys and Sir George Newman has suggested that their methods might be applied to wider fields of research. I had hoped that it might be possible to work out some such efficiency index for normal pregnancy which would have been of value in comparing one patient with another but found it impossible even in normal cases. There are so many widely divergent factors such as age, parity, frequency of successive pregnancies and general health that one cannot assess the

physiological efficiency of normal pregnancy in other than the broadest of categories. No co-efficient can embrace all the features. The wide variations in physiological efficiency in normal pregnancy are increased where the pregnancy is complicated by a cardiac affection, with the result that prognosis becomes a matter of extreme difficulty. As Starling (3) says "the criterion of cardiac failure is an individual matter and no uniform standard test can be applied to different persons".

Each case, therefore, must be examined separately on its own merits, and only by means of an exhaustive cardiological and obstetrical examination is it possible to arrive at any accurate prognosis.

EXAMINATION.

The first point of importance to be taken up in the examination of a patient suffering from cardiac disease in pregnancy, is the state of health of the patient when non-pregnant. Questions should be directed chiefly towards the amount of work the patient was capable of performing, or whether her domestic duties were heavy and if she was capable of overtaking them without distress. In not a few of my cases, the patients were capable of doing factory work in addition to domestic duties, without distress. This knowledge was of value in determining the manner in which they would respond to the burden of pregnancy. An attempt to assess the cardiac limitations might be made by observing the reactions of the patient to physical exercise. Pardee (28) makes his patients swing dumbells, 10 lbs. in weight and watches the effect of exercise upon the pulse rate. He points out that "due allowance must be made for the normal limitation of ability to exercise, which comes with pregnancy". Moreover in rating the cardiac efficiency of a pregnant woman allowance must be made for the individual variation found in different women. Some healthy women find pregnancy burdensome while others are unaffected by it.

The etiology of the cardiac condition is also of importance; a recent attack of rheumatic fever resulting in a cardiac lesion will seriously hamper the prognosis in pregnancy, as sufficient time will not have elapsed to determine whether or not the lesion is progressive.

When there is a history of chorea either in childhood or in a previous pregnancy, the prognosis should be modified. It is well-known that chorea of pregnancy is often a sequel to an attack of chorea in earlier years. When this serious complication is superimposed upon a pregnant woman already suffering from cardiac disease, the outlook is very unfavourable. The etiological factor of chorea is, therefore, an important one. One of my cases illustrated this point and may be referred to in the appendix.

The occurrence, previous to pregnancy, of respiratory complications such as bronchitis or asthma is worthy of note in that pregnancy in the later months throws a strain upon the respiratory system. This predisposes the patient to an exacerbation of her respiratory disease and, in turn, throws an additional burden on her heart.

The patient's general condition in the non-pregnant state, particularly with regard to anaemia, should not be overlooked. Five of the patients under review had a definite secondary anaemia which led to temporary cardiac embarrassment in pregnancy. Many others were in a low state of health, had a mild urinary infection or were undernourished. While these conditions were neither attributable to cardiac disease nor to the pregnancy their removal benefitted both.

Knowledge of the mental outlook of the patient is also of value. A woman who is genuinely anxious to have a child is usually a more satisfactory patient than a neurotic woman who fears pregnancy. As the patient may have to rest in bed for considerable periods during the nine months of her pregnancy, it is an advantage when she is temperamentally disposed to co-operate cheerfully with whatever treatment may be instituted.

Before taking up in detail the further examination of the patient I will draw attention to some of the etiological factors which existed in the patients who came under my observation.

The following table shows the causes to which the existing cardiac lesion might be attributed in my series of 113 cases. The table is constructed to show the primary illness from which the patient suffered and, in addition, any other illnesses which might be regarded as secondary:-

	Secondary Illnesses	Rheumatic Fever.	Chorea.	Scarlatina	Tonsillitis.	Growing Pains.	Pneumonia.	Asthma.	Bronchitis.	Exophalmic Goitre.	Diptheria.	No previous ill health.	Total.
Rheumatic Diathesis.	Rheumatic Fever.	35	6	5	6		1				1		54
	Chorea		4		2								6
	Scarlatina			5	2		1				1		9
	Tonsillitis.				7								7
	Growing Pains.					2							2
	Pneumonia						5						5
	Asthma							1					1
	Bronchitis								1				1
	Exophalmic Goitre									1			1
	Diptheria				1						1		2
	No previous ill health.											25	25
	Total.												113.

It will be noted that 35 patients had one or more attacks of rheumatic fever alone, 6 had also had chorea, 5 had scarlatina in addition to having had rheumatic fever, etc. Rheumatic fever, chorea, scarlatina, severe tonsillitis and "growing pains" were looked upon as manifestations of the rheumatic diathesis and 78 or 68.4% of the cases gave this history.

In Section I it has already been shown that rheumatic infection was a less common etiological factor, the figure there being only 46.7%.

Another point of interest in the above table is the number of patients (25) who, prior to their pregnancy, had never shown any cardiac disability or had suffered from any disease whatsoever. Among the cases quoted in the previous section the number was even higher (see page).

Enquiry will now be directed towards the patients previous obstetric history. The information which may be gathered from this source is of the greatest value but is, unfortunately, only afforded in multiparous patients. Pregnancy in the primipara is something in the nature of an experiment, but in the multiparae we are given the results of her previous experiments.

In studying the previous obstetric history in these patients 56% were found to have had distress in a previous pregnancy. It is noteworthy, however, that 44% passed through successive pregnancies without cardiac distress, the distress manifesting itself for the first time in a later pregnancy. I have appended below a table which shows the first pregnancy affected with cardiac distress in the multigravida of my series:-

	1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	TOTAL.
present pregnancy.									
2nd.	4								4
3rd.	5	6							11
4th.	3	2	3						8
5th.	3c		1d	1					5
6th.				2	1				3
7th.	1			2		1			4
8th.				1a		2			3
9th.					1				1
10th.							2	1b & 1d	4
11th.								1d	1
12th.									
13th.								1d	1

a 1 had symptoms at 4th pregnancy, none at 5th then at 6th and 7th.
B 1 " " " 8th " " " 9th
c 1 " " " 1st " " " 2nd " " 3rd and 4th.
d causative illness occurred immediately prior to this pregnancy.

In these patients who suffer from cardiac distress in successive pregnancies Lennie has pointed out that the onset of symptoms tends to occur at an earlier period with each successive pregnancy. My own observation supports this view.

In these patients who have cardiac distress for the first time in a later pregnancy (the earlier pregnancies having been free from all symptoms) it is sometimes found that the onset of symptoms is brought about by an attack of rheumatic fever just prior to the affected pregnancy. Occasionally an attack of bronchitis during pregnancy or a plural pregnancy may cause cardiac symptoms to arise where previous pregnancies have been uneventful. Nelius (31) has observed "some patients have trouble in one pregnancy and little, if any, in a subsequent one". Three of my patients bore this out. It must be concluded, therefore, that distress in one pregnancy is not sufficient evidence to assume that distress will again manifest itself in all future pregnancies. The distress present in a particular pregnancy may be due to a variety of circumstances which may not recur, such as exposure of the patient in the later months of pregnancy to unfavourable climatic conditions, e.g. winter fogs and a subsequent respiratory infection. The same patient, should she become pregnant again, might find that the later months of pregnancy (the most burdensome) occurred in the summer when the liability to respiratory infection was not so great. Thus it is of importance not only to elicit the history of cardiac distress during a previous pregnancy but also, where possible, to elicit the cause of the distress. Care may then be taken to avoid the factor which gave rise to embarrassment in her previous pregnancy.

In addition to the information regarding the patient's health during previous pregnancies useful information is to be gained in connection with her previous labours and puerperia. It is of definite prognostic value to know whether her labours have been short and have caused no marked distress, or whether they have been long and difficult. Moreover where the puerperia in the past have been of normal duration and character one can safely conclude that her heart reserve had not been overtaxed.

This information which can always be elicited from the multigravida renders the prognosis much more certain in their case than in the case of a primigravida where no such aid is forthcoming.

When making an examination in cases of cardiac disease complicating pregnancy the primary end in view is to ascertain the state of the cardiac reserve. To this end a thorough physical examination of the patient's cardiovascular system, respiratory system and urinary system is necessary. The electrocardiograph, when it is available, is often helpful. The best indication, however, of the cardiac state is the responce of the heart to effort its actual functional capacity. While this is an acknowledged and perhaps elementary basic fact amongst cardiologists its importance is often overlooked by others.

The importance of the functional capacity of the heart appears to be so great that I have examined all my cases with this idea paramount and have classified them according to their functional capacity rather than according to the lesion present.

CLASSIFICATION & CONSIDERATION OF CARDIAC SYMPTOMS IN PREGNANCY.

The American Heart Association have adopted such a classification which can be used with advantage in obstetric cases. There are four classes.

Class I - Includes all patients with organic heart disease able to carry on physical activity without discomfort.

Class II- Patients with organic heart disease unable to carry on ordinary physical activity without discomfort

IIa- Activity slightly limited (these cases rarely show signs of congestive heart failure or active infection).

IIb- Activity greatly limited (these patients show signs of congestive failure).

Class III- Patients with organic heart disease who show symptoms of heart failure when at rest. This classification is an eminently practical one and has already been adopted by Pardee (28) and Louise McIlroy (22).

The lack of uniformity in treatment of cases of cardiac disease complicating pregnancy has been already drawn attention to in Section I. Amongst the present day cases which are under review there is a similar lack of uniformity. A large variety of conflicting opinions exist as to the value of certain lines of treatment, E.G. Caesarean section and induction of abortion. Figures are quoted in support of these varied opinions.

It is my belief that before ci parison is made regarding the merits of one line of treatment with another it is essential that the cases under treatment should be comparable. This cannot be so unless there is some uniformity of classification. Such terms as "mitral stenosis" or "decompensation" are too wide in their implications to be of service in comparing one case with another. The loose use of them has led to much of the existing uncertainty in treatment.

It would, therefore, seem to be of advantage in simplification of treatment to secure uniformity of classification.

Before arranging the cases in their various groups it is necessary to devote some space to the consideration of the various signs and symptoms that arise in pregnant women subject to a cardiac lesion. Many of these have a significance peculiar to pregnancy, which slightly influences the final grouping.

The most common symptom is breathlessness. In considering it one must take into account the amount of activity required to produce the breathlessness. In pregnancy many women, who are otherwise healthy, complain of some shortness of breath particularly in the later months. In the class of patient on whom my observations have been made this is a very frequent symptom. Most of them are forced to continue their usual household duties such as washing, and cleaning until their labour actually commences. In this type of patient inquiry will usually elicit the admission that their work causes them to be slightly breathless, but its degree is never enough to cause distress or anxiety in the patient herself. Such patients are sometimes recommended to Hospital by a zealous attendant who fears cardiac breakdown. Entirely different is the case of the patient who complains of dyspnoea without any suggestion upon the part of her physician. This symptom then becomes worthy of full investigation and if found to be due to cardiac disability is a valuable indication of the severity of the breakdown.

Oedema is usually regarded as an important sign of heart failure. In pregnancy, particularly, care must be taken to ascertain whether or not the oedema is directly due to a failing heart or partly due to it, or due to some entirely different cause.

As an example of the last type the oedema met with in the pre-eclamptic state naturally suggests itself, but it is possible to have the pre-eclamptic state existing in a patient with heart disease. One of my cases showed this in marked degree. It is then difficult to determine to what extent the oedema is indicative of loss of cardiac reserve or indicative of impaired renal function. Again in the case of an exacerbation of chronic nephritis in pregnancy oedema is sometimes met with. In such a case the heart is frequently damaged and the presence of oedema is of very little value in estimating the patient's cardiac capacity. In addition to the oedema of renal origin, oedema may be present as a pressure phenomen in the later months of pregnancy. This oedema is usually slight in character. Oedema is, therefore, a less valuable indication of cardiac distress in the pregnant, than in the non-pregnant state.

Sir Thomas Lewis (31) draws attention to venous pulsation, particularly in the veins of the neck as an indication of heart failure of the congestive type. He advocates manometric measurements of venous pressure to gauge the extent of the congestion. In pregnancy the venous pulsation is of little diagnostic value. The enlarging uterus normally tends to exert increasing pressure on the abdominal reservoir and flood the cervical veins. Thus venous pulsation may occur in normal healthy patients simply as a result of their pregnancy.

Congestion and enlargement of the liver is still another sign which is often masked in pregnancy. The enlarged uterus throws forward the abdominal wall and only in the early months is it possible to palpate the edge of a congested liver.

Percussion of the cardiac borders and auscultation of the heart sounds are subject to certain normal modifications in pregnancy. The heart is normally rotated to the left and the left border of cardiac dulness is, therefore, pushed out. To find the left border of the cardiac dulness 4" or 4½" from midsternum is not uncommon in a pregnant woman with a healthy heart.

As regards the cardiac sounds the quality of these may be impaired by murmurs which, according to Gammeltoft (10) are "gestatory" in type and are of no significance whatever. Murmurs are common and, according to Newell (32), 10% of all women develope them in pregnancy and in only 2% is there an associated cardiac lesion.

If full use is made of all available clinical data, and if the variations from normal met with in pregnancy are recognised, there should be no difficulty in placing each case in its approrpiate functional group. The grouping of patients in this manner is most valuable in estimating the capability of the patient with cardiac disease to withstand the strain of labour and pregnancy.

In the following tables my cases are arranged in their functional efficiency groups. As a point of interest I have noted the lesions present in the various groups to demonstrate how patients may have varying degrees of cardiac reserve with similar pathological lesions, showing how necessary it is from a prognostic and theraputic standpoint to have some standard other than that of the pathological lesion present.

Functional Classification of Primigravidae in the Series of Cases Investigated.

Lesion or Cardiac State.	Class I.	Class IIA.	Class IIB.	Class III.	Total.
Mitral Stenosis.	-	3	2	2	7
Mitral Incompetence.	3	4	3		10
Mitral Stenosis & Mitral Incompetence.	1	1	5	1	8
Aortic incompetence & Mitral stenosis.	-	-	1	-	1
Aortic incompetence & Mitral incompetence.	-	-	2	-	2
Auricular fibrillation.	-	-	-	2	2
Paroxyomal auricular fibrillation.	-	1	-	-	1
Tachycardia (hyperthyriod).	-	1	-	-	1
Gestatomy Murmur.	1	-	-	-	1
TOTALS.	5	10	13	5	33

Functional Classification of Multiparae in the Series.

Lesion or Cardiac State.	ClassI.	Class IIA.	CLASS IIB.	Class III.	Total.
Mitral stenosis.	1	4	16	1	22
Mitral incompetence	3	17	10	-	30
Mitral stenosis & Mitral incompetence	2	5	6	2	15
Aortic incompetence	-	1	1	1	3
Aortic incompetence & Mitral stenosis	-	-	3	-	3
Aortic incompetence & Mitral incompetence	-	1	-	-	1
Auricular fibrillation	-	-	-	4	4
Myocarditis	-	-	1	-	1
Angina Pectoris	-	1	-	-	1
TOTALS.	6	29	37	8	80

It will be seen that amongst the primaparous and multiparous patients there is a variety of pathological lesions in each group. The patients in Class I did not require hospital treatment on account of their cardiac condition. In Class IIa the majority of the cases were cases of mitral incompetence, but it should be observed that there were a considerable number of cases of mitral stenosis and that the combined lesion of mitral stenosis and aortic incompetence also is represented. These latter cases were in the past, and are at present considered by many to be of a serious nature yet by careful functional grouping it is possible to assess their true gravity. The cases in Class IIa, where the patient's activity is only slightly limited, should seldom occasion alarm in pregnancy.

Classes IIb and III (the groups in which activity is greatly limited or entirely prohibited) embrace more than half of my cases. The patients who fall into these groups are those who are most likely to find pregnancy a severe, and sometimes an impossible burden. It is seen that in these groups that mitral stenosis per se, or mitral stenosis in combination with another lesion, predominate. This frequent association of mitral stenosis with severe symptoms in pregnancy led obstetricians of the past to regard the lesion with rather an exaggerated respect. The fact that mitral stenosis can exist without giving rise to any disquieting symptoms (as shewn by the number of cases of mitral stenosis in Classes I and IIa) was not fully appreciated.

The reaction of the patient to the strain of pregnancy and labour and the mortality rate varies in the different classes. The treatment of the patient in my opinion should depend entirely on the class into which she falls. While it is impossible to utilise a universal line of treatment for all cases of pregnancy associated with cardiac disease, it would be wise to establish a uniform mode of treatment in each class. Within certain limits this can be done as will be shewn later when further reference will be made to the varying behaviour in pregnancy or patients in the different classes.

The Use of the Electrocardiograph in Obstetric Cases.

In the consideration of physical examination of patients with a view to their classification, mention has been made of the value of the electrocardiograph. This instrument, used largely by cardiologists, might be employed with advantage in all cases of pregnancy where there is a damaged heart.

In some of the larger continental clinics and in the Royal Free Hospital in London this has already been done, but its use even in these clinics has been confined almost entirely to research, and the use of the instrument has been more experimental than utilitarian.

"The functional equilibrium of the two ventricles is disturbed in most cases of pregnancy even in the normal ones" says Gammeltoft, but the changes shewn electrocardiams in normal pregnancy are slight. In order to appreciate them it is necessary to take, as Gammeltoft did, a large series of electrocardiograms of the same patient at short intervals. The electrocardiograph, however, is helpful to the physician in an even more practical way. According to Price (34) the electrocardiogram "is the most precise means at our disposal of investigating the state of the myocardium". One of the greatest difficulties which besets the physician in charge of a pregnant woman with a damaged heart is the difficulty in prognosis. Will the patient who shows signs of distress at about the fourth month be able to carry her pregnancy till term without running a very grave risk? Or again, a patient may show a gratifying response to treatment, and the question arises is this response likely to be permanent or merely temporary. Help is often gained by recourse to the electrocardiographic findings.

In the type of case usually classified in group IIb the electrocardiograph is useful. This type of case is always on the borderline of complete cardiac breakdown. According to Rae Gilchrist (35) most cases in class IIb can, with adequate treatment, be improved until they fall into class IIa. There are some, however, who do not respond to treatment and it is my opinion that these latter cases can generally be discovered by electrocardiographic means. The earlier such a case is discovered and the sooner her pregnancy is terminated the more certain is her recovery. One patient in my series was electrocardiographed at $3\frac{1}{2}$ months and her heart muscle found to be poor. Her pregnancy was immediately terminated on the electrocardiographic findings. The patient was sterilized and at the follow up one year later was alive and comparatively well. The electrocardiograph has proved to be a useful adjunct to physical diagnosis. By its use in some cases myocardial damage may be detected before severe clinical symptoms manifest themselves, thus enabling radical termination of the pregnancy to be effected before the

patient's condition becomes hopeless.

It is unnecessary for obstetricians generally to attempt to become expert in the elucidation of electrocardiograms, and in this department particularly, the co-operation of physician and obstetrician would be of considerable value.

It seems to me to be particularly in the early months of pregnancy that the electrocardiograph will prove most useful. The early detection of those cases in which marked symptoms have not appeared, but which may eventually break down owing to inherent myocardial weakness, is difficult by other clinical methods. In the later months the electrocardiograph will seldom be necessary, as readily appreciable symptoms will have become obvious at the bedside.

Another feature of electrocardiographic observations in the obstetric patient is the detection of abnormalities in the cardiac rhythm occasionally in the conductivity. In my series of 113 consecutive cases there were three cases of auricular fibrillation, two of which I was able to demonstrate electrocardiographically. These latter patients had normal unassisted deliveries. Both cases are alive at the time of writing and in one a normal rhythm has been re-established. The other case is still fibrillating but is remarkably well under the influence of digitalin. These cases are of considerable interest in that they were able to withstand the strain of a normal labour.

With regard to the defects in conductivity, one patient had a right bundle branch block. She was a primipara. I was unfortunately only able to secure an electrocardiogram when the patient was $3\frac{1}{2}$ months pregnant. She then refused all treatment and left hospital irregularly. This patient was visited in her home. She was able to remain on her feet throughout her pregnancy provided she rested for several hours each day. She consented to have her confinement in hospital and this was effected by means of a low forceps delivery, after 21 hours in labour. The patient has made excellent progress and the pregnancy does not appear to have caused ill effects. Hermann and King (36) have quoted two similar cases and observe "bundle branch block is a considerably more serious complication and increases the risk in obstetric, and also in surgical cases more than does auriculoventricular block.

In my series there was no case of complete auriculoventricular block but since closing the series I have observed one case. Although this case is outwith the series it is an example of so rare a condition (pregnancy and complete heart block) that I consider it worthy of special reference.

Case of Pregnancy & Complete Heart Block.

Mrs. Shields, Age 30, 4 gravida, admitted on 16th April, 1932, on account of commencing cardiac failure. Patient was seven months pregnant and had been in medical wards of Glasgow Royal Infirmary two months previously on account of cardiac breakdown.

On admission she was orthopnoeic and had oedema of feet and ankles. There were fine crepitant rales at the lung bases. The pulse rate was 90-100 and the B.P. 115/75 M.M. There was a trace of albumen in the urine. The valvular lesion was one of combined mitral stenosis and incompetence. She belonged to the Group IIb type. After twenty-six days of complete rest the symptoms did not improve, the oedema was increasing and the patient's physician ordered Guy's pill four times daily, this was stopped after 12 days on account of a sudden drop in the pulse rate from 85/ min. to 45/ min. On the following day the pulse rate fell to 33/ min. and remained at this level for two days. On the third day of tachycardia the patient went into premature labour and delivered herself spontaneously and precipitately of a live infant (6 lbs. weight). The pulse rate rose on the third day of puerperium to 45/ min. and ran between 45-55/ min. until the 18th day when the patient was dismissed to her home where she was confined to bed for a further period of eight weeks. During the three days when the pulse rate was between 32-40/ min. the patient was not unduly distressed. She was quite unaffected by her actual labour which was precipitate and she improved considerably thereafter. She was seen at a "follow-up" six months after dismissal and was found to be suffering from auricular fibrillation with a pulse rate of 140-150/ min.

Unfortunately the patient was too ill antenatally to risk the necessary transfer for electrocardiographic records to be taken. Since her return home she was so severely crippled by her cardiac disablement that she was not able to make the journey to hospital for electrocardiographic purposes.

Hermann and King (36) also quote one case of complete auriculo ventricular block in a patient present since the age of 20. This woman had six successful deliveries without complication and her heart rate was never above 40/ min. These striking cases should occasion some hesitancy when considering termination of a pregnancy by surgical means, e.g. Caesarean section when one considers that in neither did labour appear to distress the patient unduly.

To apportion the place of the electrocardiograph in obstetrics I have taken the liberty of quoting Allan's (37) dictum in "Defects in Cardiac Rhythm in Relation to Cardiac Failure" which seems to be exactly applicable to the obstetric field. "The ability to analyse the different defects in cardiac rhythm has more than an academic value and is a distinct aid in arriving at a decision in many cases of disease of the circulation. A knowledge of the type of irregularity will not take the place of a careful enquiry into the patient's symptoms or examination by other means, but it is in many cases a very important factor in completing a diagnosis, or in building up a prognosis; while in some cases it provides a definite indication for specific treatment."

This enunciates exactly the place of electrocardiography in obstetrics.

ANALYSIS OF TREATMENT WHICH WAS EXTENDED TO THE SERIES OF CASES UNDER REVIEW.

It is not my present purpose in the following analysis of treatment to discuss the merits or demerits of any one form extended to the present series of cases. The observations will simply record the facts. Having done so I will proceed to outline what I consider to be the ideal treatment for patients suffering from pregnancy complicated by cardiac disease.

It must be understood from the outset that the treatment of many of these cases was in the nature of emergency treatment, many were sent into Hospital after outside attempts at treatment had failed. Comparatively few patients with cardiac disease were in-patients early in their pregnancy, although many had attended antenatal clinics from an early date.

The antenatal treatment was largely medical and conservative, only two cases were treated surgically, i.e. by termination of pregnancy in the early months. The basis of the medical treatment was rest in bed. In the first Section, it will be recalled, rest was shown to be the basis of antenatal treatment. Amongst the present day cases this is more effectively carried out; the patients, as a whole, have a longer stay in Hospital. Two of the series were in-patients for over six months. There is no parallel to this amongst the earlier cases where the longest stay in Hospital was six weeks and the average was under seven days. The appreciation of the value of rest and institutional treatment for such patients has grown very considerably.

Another favourable feature of present day medical treatment is the attention which is paid to the treatment of adventitious factors which may have the effect of aggravating the cardiac disability such as bronchitis pyelitis of pregnancy or a mild toxaemia.

Patients whose cardiac condition per se gives no cause for alarm, are frequently admitted to Hospital on account of some other condition which, if left untreated, would eventually overtax the damaged heart.

The drugs exhibited in the treatment were similar to those used twenty years ago but the dosage at present appears to be more adequately controlled. In several instances massive doses of digitalis have been administered (half a drachm per stone body weight) with excellent results. The satisfactory results were met with in the cases of auricular fibrillation. Two cases of tachycardia which were subjected to massive digitalis therapy showed toxic symptoms before an appreciable improvement occurred and the treatment was abandoned. Intravenous injections of strophanthin was used in antenatal emergency cases and immediately after delivery. This mode of administration is particularly effective and was never attempted in the earlier series. Dicting followed the same lines as in the past and diuresis was promoted according to long-established practice.

One feature of medical treatment of some of the cardiac patients to-day is the administration of glucose by the mouth ($\frac{1}{2}$ lb. daily). It might be used much oftener than it is with advantage. I consider that the administration of glucose is a most rational form of treatment. In pregnancy the foetus draws its carbohydrate from material sources in the form of glucose. This carbohydrate withdrawal becomes heaviest at the 7th month (Feldman 38). The strain on the damaged heart is great at the 7th month and the administration of glucose particularly at this time may help to make good the loss of maternal glucose brought about by the foetus.

An interesting observation on the present treatment as compared with that of some years ago is the comparative disfavour into which strychnine and alcohol has fallen. Neither stimulant is used to anything like the extent it was formerly.

MODE OF DELIVERY ETC.

Examination of the following table will indicate the manner in which delivery was effected in the series:-

MODES OF DELIVERY IN PRIMIGRAVIDAE AND IN MULTIPARAE IN THE SERIES.

		Class I.		CLASS IIA.		CLASS IIB.		CLASS III.	
		Primi-para.	Multi-para.	Primi-para.	Multi-para.	Primi-para.	Multi-para.	Primi-para.	Multi-para.
Spontaneous Delivery.	At term	2	5	5	15	4	14	-	3
	prematurely.	1		1	8	2	2		2
Abortion	Spontaneous	1			1				
	Induced.						1		
Surgical induction of premature labour.									
Forceps or Craniotomy.	At term		1	3	2	1	4		1[4]
	Prematurely.					2		1	
Manual Extraction of Breech.							2		
Abdominal Hysterotomy.						1			
Undelivered.				1[5]				2[6]	
Caesarian Section for Cardiac Disease.	At term				2	2	5		
	Before term.				1[1]	1	8[2]	2	2
Caesarian Section for Contracted Pelvis, etc.		1[3]					1		

1. Child died.
2. Twins died in one of these cases.
3. N.B. Section for C.P. not Cardiac Disease sterilisation.
4. Craniotomy performed in one of these cases.
5. Irregularly dismissed.
6. Died undelivered.

In Group I the primigravidae and multiparae were little or not at all disturbed by labour, the vast majority being delivered spontaneously.

Amongst the primigravidae in Group IIA 60% had spontaneous deliveries while 30% had forceps deliveries. These forceps deliveries were performed to save the patient the strain of the second stage of labour. The multiparae as might be expected, show a higher rate of normal delivery namely 79%. Of the twenty-nine cases in this group (IIA) two patients had Caesarean Section and sterilization performed at term and one before term.

In Group IIB (where the patients activity has been greatly limited by her cardiac state) the analysis is most interesting. Amongst the primigravidae 46% had spontaneous deliveries (two being premature labours). Forceps was applied in 23% and Caesarean Section and sterilization was performed on 23% while one pregnancy was terminated in the early months. Of the multiparae in the same group 43% delivered themselves spontaneously, 11% were delivered by forceps and 35% were delivered by Caesarean section and were sterilized. It is of particular interest to note the wide variations in mode of delivery amongst patients whose cardiac state was similar.

In Group III (the group in which definite heart failure was established), the numbers are too small to justify quoting percentages but it is noteworthy that two Caesarean Sections were performed on primigravidae and two on multiparae before term.

Where anaesthesia was necessary the anaesthetic varied according to the accoucheur in charge. Some patients received chloroform only, others nitrous oxide and oxygen only and others spinal anaesthesia. Ether was eschewed by all.

The relationship between the varying modes of delivery and the mortality rate will be discussed later.

While considering the mode of delivery it is interesting to note that the prematurity rate amongst those cases delivered spontaneously was 25% (16 out of a total of 64).

TREATMENT IN THE PUERPERIUM.

Here again there was some variation in treatment. Some patients were allowed to suckle their infants at the breasts while others were prohibited from doing so. Certain patients received the most vigilant after-care while others were regarded as normal when their delivery was successfully completed. The question of prevention of future pregnancy was rarely raised by the physician although patients were on occasion instructed regarding contraceptive measures which might be taken.

That sudden death occasionally occurs early and unexpectedly in the puerperium in women suffering from cardiac disease is well recognised. Many obstetricians of wide experience have personal knowledge of such cases. I have not met with this phenomenen in my series which comprises all the cases admitted to Hospital in fourteen months.

Nor could I discover a case in the three year series quoted in the first section. From this it would appear that sudden death occurring unexpectedly in the early days of the puerperium, when the trials of delivery have been successfully overcome, is rather an uncommon occurrence.

CONSIDERATION OF THE FATAL CASES.

The following table specifies the fatal cases which occurred in the series:-

TABLE SHOWING THE FATAL CASES IN THE SERIES.

Case No.	Parity.	Class.	Maturity when Delivered.	Length of Stay in Hospital.	Mode of Delivery.	Pathological Lesion.	Remarks.
1	1st.	III	30 Weeks.	11 Hours.	Undelivered.	Mitral stenosis & Aortic incompetence.	P.M. Advanced vegetive endocarditis with general congestive heart failure.
2	1st.	III	34 Weeks.	12 Days.	Undelivered.	Mitral Stenosis.	
3	1st.	III	36 Weeks.	49 Days.	Caesarean Section & sterilisation. (twins)	Mitral Stenosis.	Developed puerperal endocarditis on 7th day of puerperium (confirmed by consultant physician). Died on 38th day.
4	1st.	III	33 Weeks.	66 Days.	Caesarean Section Sterilisation.	Mitral Stenosis.	Died on 2nd day of puerperium.
5	4th	IIB	Term	19 Days.	Spontaneous.	Mitral incompetence & Stenosis.	P.M. Ulcerative endocarditis. Died on 8th day.
6	5th	IIB	Term	15 days in Antenatal then dismissed.	Spontaneous (in ambulance).	Mitral incompetence.	P.M. Bronchopneumonia. Myocardium very poor. Died on 8th day.
7	4th	IIB	Term	80 Days.	Caesarean Section sterilisation.	Mitral stenosis. & Aortic incompetence.	Died on 24th day after delivery.
8	6th	IIB	Term	27 Days.	Caesarean section sterilisation	Mitral stenosis.	P.M. Old standing mitral stenosis. Died 14 Hrs. after operation.

TABLE CONTINUED.

Case No.	Parity.	Class.	Maturity when Delivered.	Length of Stay in Hospital.	Mode of Delivery.	Pathological Lesion.	Remarks.
9	3rd.	III	Term.	50 Days.	Spontaneous.	Mitral Stenosis.	Auricular Fibrillation. Died 4th day of puerperium.
10.	7th.	III.	30 Weeks.	23 Days.	Caesarean Section sterilisation.	Mitral Stenosis.	Auricular Fibrillation. Died 6th day of puerperium.

It will be seen that the deaths occurring amongst primigravidae all occur in Group III. In multiparae four cases were in Group IIB and two in Group III. It will also be noticed that with one exception the cases were in-patients of the Hospital for a reasonable length of time ranging from 12 to 80 days.

Probably the most striking feature is the reduction in the numbers of patients who died undelivered. Two cases or 1.7% of the admissions to Hospital on account of cardiac disease died undelivered, whereas in the earlier series nine patients or 6.4% of the patients with cardiac disease died undelivered.

This reduction is a favourable feature which I consider is due to the more adequate antenatal care which is now extended to pregnant women suffering from cardiac disease.

Considering the gross mortality rates in both series it will be observed that in the present one there were ten deaths in 113 consecutive admissions. The mortality rate is thus 8.8%. In the first series there were 139 cases made up of the consecutive admissions in 1910, 1915 and 1920. Of these 139 admissions there were twenty deaths, the mortality rate being 14.4%. The mortality rates for the three individual years were 8.9% in 1910, 19.4% in 1915 and 17.3% in 1920. Thus the gross mortality rate in the present series of 8.8% is as low as the lowest of the previous years and much lower than the average.

In the case of primigravidae, in the earlier series the mortality rate was 21.5% and in the present series was 12.0%. The mortality rate amongst Multiparae in the first series was 11.0% as against 7.5% in the present series.

Any lowering of the mortality rate which has occurred during the last decade would appear to concern chiefly deaths in undelivered cases as the death rate amongst delivered cases shows no appreciable alteration and is 7.5% in the earlier and 7% in the later series.

It is now necessary to consider the fatalities regarding the manner in which the deliveries were effected. The present series of cases are grouped according to their functional disability. It is, therefore, possible to compare cases within the same group and to contrast the results obtained by different methods of delivery.

In the earlier series, where there was no adequate classification, it was impossible to contrast one case with another as the degree of disability varied amongst patients with similar lesions.

I have correlated below in tabular form the various methods of delivery and the deaths which occurred thereafter. It must be clearly understood at the outset that this correlation does not imply "cause and effect". The natural evolution of the disease was the cause of death and the mode of delivery either accelerated it, or failed to prevent it, but could not be said to cause it.

CORRELATING MODES OF DELIVERY & FATALITIES IN THE DIFFERENT GROUPS.

Mode of Delivery.	Group I		Group IIa		Group IIB.		Group III.		All Groups.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Spontaneous delivery.	8	Nil	29	Nil	22	2	5	1	64	3
Caesarean Section.	Nil	Nil	3	Nil	16	2	4	3	23	5
Undelivered.	Nil	Nil	1 ø	Nil	Nil	Nil	2	2	3 ø	2
Other forms of delivery (in which there were no deaths).	3	Nil	6	Nil	12	Nil	2	Nil	23	Nil.

ø One case was irregularly dismissed.

As will be observed and as would be expected there are no deaths in either Group I or Group IIa. The mode of delivery in these first two groups is of little importance as the patient is able to withstand the strain of any form of delivery without serious danger to life. Whether in these mild cases the heart is strained by one method of delivery more than by another will be discussed later.

In Group IIB twenty-two patients delivered themselves spontaneously and thereafter two died. Sixteen patients in the same group underwent Caesarean Section a sterilization and two died. Although the figures are small they cover thirty-eight cases of the similar type and the mortality rate after the latter method of delivery compares unfavourably with that of the former. This is of particular interest in that in the first series of cases of earlier years Caesarean Section was never performed and the question arises as to the value of the innovation.

In Group III the cases where cardiac failure was definitely established, five patients delivered themselves spontaneously and one died, while four underwent Caesarean Section and three died. In this group there were two cases died undelivered.

Twenty-three patients were delivered in different fashions from those which have been already mentioned. These consisted of forcep deliveries, abortions, induced and spontaneous and one case of abdominal hysterotomy.

The Department Committee on Maternal Mortality and morbidity have shewn that cardiac disease is responsible for 5% of the maternal deaths from all causes. In a recent investigation into Institutional Maternal Mortality Professor Munro Kerr and the writer found that 7.7% of all the fatalities in the Glasgow Royal Maternity Hospital over a period of five years were due to this condition. It is, therefore, evident that the problem merits very serious consideration. Moreover when the patients whose hearts are affected, successfully carry through a pregnancy and confinement the question of their future disablement is of some moment.

AFTER HISTORY.

I was able to follow up a considerable number of the patients (57) in the present series. The results as regards those in Group I and Group IIA were without exception satisfactory. Cardiac disability did not appear to have been appreciably

increased by the pregnancy. In Groups IIB and III the results were far from satisfactory. I have to record two deaths (one from each Group) within six months of dismissal. Seven patients were suffering from auricular fibrillation. The majority found their activities considerably limited and in a few the expectation of life was poor. While their condition was not due directly to their pregnancy there is no doubt that the pregnancy aggravated their difficulties but it is impossible in our present state of knowledge to assess exactly the extent aggravation incurred.

DISCUSSION ON TREATMENT OF THE PREGNANT WOMAN SUFFERING FROM CARDIAC DISEASE.

In the light of the foregoing investigations into past and present patients certain very definite improvements in treatment suggested themselves. The treatment of primigravidae and multiparae differs in certain respects but in others presents a common problem.

It is essentialin the first place to secure for the patient early antenatal care. Her condition in the first few months is often the key to the prognosis for the whole pregnancy. Whenever possible the patient should be examined by the person responsible for her ultimate confinement. The patients should all be classified according to their functional disability. Meticulous care should be exerted to ensure accuracy of classification as their ultimate treatment will be based upon the class into which they fall. To this end the opinion of a cardiologist may require to be sought, and there is no doubt that a closer liaison between physician and obstetrician would greatly benefit this type of patient. In all cases where the prognosis is doubtful the patients should be admitted to Hospital or Nursing Home where they may be carefully observed. Electro cardiograms, X-ray photographs and exercise tests will all help to narrow the prognosis in the doubtful case.

Having carefully "grouped" the patient further treatment depends upon to which Group she belongs and to whether she is a primigravidae or not. I consider that both primigravida and multiparae of Groups I and IIA need very little treatment so far as their pregnancy is concerned. The exercise of reasonable caution, the avoidance of any great exertion is all that is necessary to ensure their safety in pregnancy.

As has already been pointed out pregnancy is normally a physiological process and throws very little strain on the heart which hypertrophies to meet its requirements. Thus the patients in Group I and Group IIA, where the damage to the heart is not severe, can safely weather a normal pregnancy. As regards their actual labour this should be cut short by means of forceps delivery at the commencement of the second stage. This treatment is suggested in order that the heart may be spared the strain of the sudden alterations in blood pressure which occur in the second stage of labour. Although the strain of the second stage is not likely to have serious affect on the heart of a patient in Group I or IIA it is wise to spare even the slightest strain, by the simple expedient offered in forceps delivery. An alternative method of delivery may be offered to multiparae in Groups I or IIA, more particularly the latter. They may be delivered by Caesarean Section and undergo sterilization.

The objects of the operation in these cases would be to secure a live child and sterilize at the same time, not as an immediate means of saving life, for cases in these groups are not in danger of death in childbirth. The justification for this procedure would be the prevention of a future pregnancy which might occur when, owing to the natural evolution of the disease, the patient's cardiac condition was more grave. Caesarean Section and sterilization presents no difficulty in these cases and as has been shown by Lennie (3) has relatively good results. The same operation in a primigravidae has certain disadvantages. By precluding the possibility of further childbearing the patient's family is limited to one child, and it is questionable whether such limitation is justifiable in a patient whose cardiac disability is not great.

The treatment of patients in Group IIB where the activities are greatly limited presents certain difficulties. Many widely varying opinions voiced regarding their treatment, Hamilton and Kellogg (39) advocate abortion and sterilization whenever signs of heart failure appear. W.B. Hendry (40) advocates Caesarean Section when the child is viable and Verco (41) considers conservative treatment on medical lines with surgical induction when "orthopnoea pulmonary oedema or a pulse rate over 100 persists", Smythe (42) upholds induction of labour at the 36th or 38th week and gives as his reason that the passage of a small child causes less strain to the mother.

The treatment must depend entirely on when the patient is seen by the accoucheur. A multiparous woman in Class IIB who consults her physician in the early months of pregnancy should have that pregnancy terminated at the earliest opportunity. It may be wise to allow the patient's condition to improve by a short period of preliminary rest but temporary improvement in her condition should not be considered as a contra indication for termination. Rae Gilchrist (35) has pointed out that with careful medical treatment cases in Class IIB may be improved to the extent that they fall into Class IIA.

In the case of the woman who has already borne children and whose value to her family and the community, as a mother is inestimable, it does not seem prudent to delay the termination of pregnancy which may prove fatal. Even where the fatal issue is averted her cardiac condition may be, and usually is, so impaired as to render her a life-long invalid. It is usually in the interests of the unborn child that such women are allowed to continue from the early months of pregnancy to term byt the maternal fatalities which not infrequently result from the experiment render the risk unjustifiable. In the case of a primigravida the difficulty is even greater. It is difficult to forecast the reactions of a normal primigravida to her pregnancy. In the case of a primigravida with cardiac impairment of the IIB type prognosis is impossible. In some cases, as Rae Gilchrist has pointed out, careful medical supervision throughout pregnancy has satisfactory results. In others, the heart fails rapidly as pregnancy advances. Termination of the pregnancy in the early months is always the safest course. Where the patient expresses an ardent desire to continue the pregnancy she should always be informed as to the possible dangers she may be incurring. If her attitude then remains unchanged she must remain under the closest supervision throughout pregnancy.

In this connection I would like to stress the value of "Therapeutic exercises" in patients who are to be confined to bed for lengthy periods. It is particularly necessary that women should prepare themselves for the strain of the labour which is approaching. Prolonged rest in bed without any form of exercise has deleterious effect upon the patient.

When a multipara or primigravida has advanced beyond the 28th week of pregnancy before being seen by the obstetrician there are various modes of treatment available and around these considerable controversy exists.

There are those who advise termination of pregnancy when the child is viable or at term, by surgical means. They constitute the majority of contemporary opinion. The minority with which the writer associates himself, prefer to avoid surgical interference in these cases.

Some of the radical school suggest as treatment Caesarean Section (and sterilization) particularly W.B. Hendry (39), Hamilton and Kellogg (4) and Chrichton Bramwell (43). Others adopt surgical induction on, at or about the 36th week prominent amongst whom are Verco (41) and Smythe (42). Considering first the latter method that of surgical induction of labour, this method was largely used amongst the earlier cases I have quoted. The results were far from satisfactory, Jardine (13) whose experience of the procedure was immense had "grave doubts as to the propriety of the operation". The obvious disadvantages of this operation have been discussed in the first section and as there has been no progress made in the technique of surgical induction since the earlier cases were dealt with there is no reason to revert to a line of treatment which proved little short of disastrous in the past. The successor to surgical induction is Caesarean Section. Caesarean Section offers many advantages that its predecessor lacked. Those whose practise Caesarean Section as against conservative treatment and natural delivery claim that the operation (1) spares the patient the strain of labour and (2) affords an opportunity for sterilization. Some advocates of the operation perform it whenever the child is viable (or about the 36th week) in an endeavour to spare the mother the strain of the last few weeks of pregnancy. While remembering the reasons annexed for performance of Caesarean Section and sterilization it is interesting to consider the disadvantages of the operation which I consider outweigh any possible advantage.

The cases in Class IIB are those in which there are definite signs of commencing heart failure. The most prominent sign in such cases at the 32nd-36th week (the time of operation) is a commencing pulmonary oedema. Caesarean Section and sterilization is an operation which in the hands of experts seldom takes less time than fifteen minutes. In other hands may last over half-an-hour. The operation incurs a certain amount of shock. The sudden emptying of an abdominal viscus of the size of a 36 weeks uterus, while having a negligible effect on a patient with a contracted pelvis and normal heart,

is a more risky undertaking when there is an imminent danger of cardiac failure. The effect of the anaesthetic upon the patient must also be considered. There is such very great divergence of opinion upon the question of which anaesthetics are safe and which are unsafe in this operation that the "seeker after the truth" is inevitably forced into the belief that all have disadvantages. In support of this contention I would quote MacKenzie who favours Chloroform. Against this Young (44) who voices the opinion of many when he states "the anaesthetic of choice for this operation is ether, Chloroform being a depressant is contra-indicated". Van Jaschke (17) view is "a lumbar anaesthesia, never in any case under an inhalation narcosis". DeLee supports ethylene morphine and scopolamine and novacain. All have their disadvantages. The inhalation anaesthesias tend to aggravate the pulmonary oedema which is already present. This has been borne out by my own observations on cardiac patients dying after Caesarean Section, the majority of which show acute pulmonary distress. Against the administration of spinal anaesthesia is levelled the criticism that the alteration it causes in the blood pressure has a deleterious effect on the heart. My experience of spinal anaesthesia in cardiac cases is too limited to permit of comment upon this view.

The operation just described is claimed to save the patient the strain of labour. The operation itself is undoubtedly a strain on the patient and the question of which strain is greater arises. This can only be decided by careful observation of a large series of cases actually in labour. It has been observed by many obstetricians that patients with cardiac affections have surprisingly rapid labours. A considerable number of the patients in the present series were singled out for Caesarean Section at term and without warning delivered themselves spontaneously before the operation could be performed. These patients showed no ill effects from their actual labour. It was this fact that first led me to question the wisdom of performing the operation at all. The observation of these normal labours involved noting the length of time they occupied. Eleven primigravidae and thirty-seven multiparae were therefore timed. It was found that the average length of labour in the primigravidae from the onset of the true labour pains, until the completion of the second stage was slightly less than eight hours.

In the multiparae the labours were shorter and averaged six hours. The longest labour in a primigravida lasted twenty-two hours and the shortest was precipitate being completed in one hour. Amongst the multiparae the longest labour was twenty-one hours and the shortest one and a half hours. It is impossible to state definitely what is the normal duration of labour in a normal healthy woman. Whitridge Williams (45) states "generally speaking the average for a primipara is eighteen hours of which sixteen are occupied by the first stage,in multipara it is about twelve hours, eleven of which are occupied by the first atage".

Comparison of the two sets of figures, Williams for normal labour and my own for labour in cardiac cases shows a marked shortening in time for the latter cases. In many of the cases I observed the first stage presented unusual characteristics. The patient complained of a vague abdominal uneasiness which could not be definitely diagnosed as the onset of labour until careful examination had been made. Occasionally where a vaginal examination was made at the time this "uneasiness" was first complained of, it was found that the os was almost fully dilated. This shortening of the first stage is of considerable importance. With the possible exception of five cases in Group III it can be stated that real distress was never observed during the first stage of labour in patients with cardiac disease. Those who were delivered by forceps at the commencement of the second stage of labour thus avoided almost entirely the strain of labour. Those who were allowed to progress in the second stage usually showed signs of distress notably increasing dyspnoea, rise in pulse rate, and varying degrees of cyanosis. The blood pressure which was observed in some of these cases showed considerable variations with and between the pains which undoubtedly accounted for the cardiac distress.

From these observations I conclude that, in a patient with cardiac disease, labour is generally shorter than in a normal case. Also that owing to the peculiarities of the first stage the strain on the patient is not so great as is generally supposed.

Having compared the strain imposed by Caesarean Section and the strain imposed by normal delivery the second indication for operative interference may be considered.

The operation affords the opportunity of sterilization. The aim is an excellent one. Sterilization is usually the only method of preventing further pregnancies in the hospital class of patient. They are usually too poor or too careless to carry out adequate contraceptive measures. While the aim is excellent it must be admitted that the operation necessary to fulfill it is a drastic one. A patient who has not only a damaged heart with signs of commencing failure, but who is also burdened with an advanced pregnancy, is subjected to a major surgical operation. It would seem a wiser course to wait until the present pregnancy terminated, and when the patient had to some extent recovered, prevent future pregnancies by sterilization. The operation of sterilization apart from Caesarean Section is a less serious undertaking and may well be performed in a few minutes when the patient is in a fitter condition to stand it. If the patient after pregnancy is not considered to be a fit subject for surgical interference sterilization may be brought about by X-ray. The distress of an artificial menopause which may result from such treatment cannot be compared with the dangers of the pregnancy which it prevents. Louise McIlroy carries out the procedure at the Royal Free Hospital but it must be admitted that the method is not one of choice.

Before leaving the question of the treatment of patients in Class IIB seen for the first time when advanced in pregnancy, the mortality rates following on the different methods in my series of cases must be mentioned. Six primigravidae were delivered spontaneously and three by Caesarean Section without any fatalities occurring. Amongst the multiparae sixteen were delivered spontaneously, four by forceps and two manually extracted breeches with a total of two deaths. Thirteen patients underwent Caesarean Section and sterilization and two died. Thus in twenty-two cases delivered per vias naturales there were two deaths as against a similar number of deaths in thirteen cases of Caesarean Section. While these figures are admittedly small they tend to bear out the arguments propounded in favour of conservative treatment of this class of case.

The final group of patients falling into Group III show a poor response to any form of treatment. Undoubtedly many of the fatalities in this group could be averted if the patients were under adequate care early in their pregnancies. Many patients who

are in Group IIB early in pregnancy and whose pregnancy might then be terminated with a reasonable degree of safety, progress to the later months and fall into Group III with established cardiac failure. From observations on the series I am able to show that the varying degrees of cardiac failure evince themselves in the majority of cases, early in pregnancy. The most severe cases as would be expected, break down early. Therefore, it is of paramount importance to treat these cases by surgical termination of the pregnancy before the advanced pregnancy and concomitant cardiac failure renders the surgical risk too great. To stress the point that cardiac symptoms of varying degree manifest themselves first in the early months when their significance may be determined and adequate treatment administered, I submit the following table:-

Table showing the period at which first symptoms of Cardiac distress manifested themselves.

Pregnancy under Observation	1st Month.	2nd Month.	3rd. Month.	4th Month.	5th Month.	6th Month.	7th Month.	8th Month.	9th Month.	No Aggravation of Symptoms.	Totals.
First pregnancy.	1	3[c]	4	3	5	3	4	-	-	10[ab]	33
2nd preg.	-	2	3	1	1	-	1	1	-	2	
3rd "	3[c]	2	2	1	1	1	3	2	-	2	
4th "	-	-	5	-	1	3	3	-	-	-	
5th "	1	1	3	1	-	1	-	-	-	1	
6th "	1	-	-	-	-	2	-	1[d]	-	-	
7th "	-	3[d]	1	2[d]	1	-	1	1	-	1	
8th "	-	-	-	1	3	-	1	-	-	-	
9th "	-	1	1	1	1	-	-	-	-	-	
10th "	1	-	1	1	2	-	-	-	-	-	
11th "	-	-	-	-	-	1	-	-	-	-	
12th "	-	-	-	-	2	-	-	-	-	-	
13th "	1	-	-	-	-	-	-	-	-	-	
Total.	8	12	20	11	17	11	13	5	Nil	16	113.

It will be seen that the large majority show symptoms before the seventh month when termination of pregnancy is relatively safe. Cases which show symptoms of distress at a later period rarely if ever fall into Group III which is now under consideration. When Group III patients are seen for the first time late in pregnancy the prognosis is bad whatever treatment is carried out. Of the five primigravidae in the group four died, two undelivered and two after Caesarean Section and sterilization.

a. One with symptoms during labour.
b. One with sumptoms after labour.
c. One at two months aborted on admission.
d. One causative illness occurred immediately prior to the pregnancy.

Of the eight multiparae in the group two died, one after spontaneous delivery and one after Caesarean Section. It is more profitable to enquire into the history of these patients in the group who managed to survive their pregnancy. The single primipara received massive doses of digitalis ($\frac{1}{2}$ drachm, per stone body weight) and was finally delivered by craniotomy at the commencement of the second stage. Of the six multiparae who lived, four survived normal delivery, one survived a forceps delivery and one survived Caesarean Section.

The reasons which I have enumerated us militating against Caesarean Section as a mode of treatment in cases of Group IIB operate still more forcibly in cases of Group III. No surgeon ever considers such a case as a "good operative risk" and it is only performed as a last resort. Those cases which under appropriate medical treatment have survived a delivery per vias naturales prove that the operation is not a last resort, and the high mortality resulting from the operation in this type of case render it, in my opinion, altogether unjustifiable.

SECTION II

Summary of the Investigation of 113 Consecutive Cases personally examined between 1st December 1929 and 31st January, 1931.

1. The bulk of modern opinion holds that pregnancy in cardiac disease may be "a dangerous experiment". My investigation has borne this out. Recent advances in the physiology of the heart in pregnancy have shown however that in the less serious forms of heart disease the danger in pregnancy is very slight.

2. The prognosis in pregnancy depends almost entirely upon the degree of cardiac reserve - a fact which appears to be more generally recognised now than formerly (cf. Section I).

3. A careful examination must determine the degree of cardiac reserve present. Such an examination must concern the etiology, parity, capacity for work, etc. These points have been discussed in detail.

4. The usefulness of the electrocardiograph as an adjunct to examination has been discussed and commended.

5. The classification of pregnant patients with cardiac disease has remained unchanged and is unsatisfactory. A new one based upon the heart's functional capacity has been advocated.

6. An analysis of present-day treatment in the antenatal period, in labour and in the puerperium has been carried out and the results compared with those of former years. Any improvement was found to be in regard to antenatal treatment.

7. The mortality rate was investigated and compared favourably with the earlier rates (cf. Section I). There was no improvement, however, in mortality after delivery although new methods (notably Caesarean Section) had been adopted.

8. The late results of pregnancy upon the heart were commented upon and were found to be serious in many cases.

C O N C L U S I O N S.

1. A mode of classification of cardiac disease in pregnancy, based upon the functional capacity of the heart, should be generally adopted. Such a classification would be used as a basis of treatment, the present anatomical classification being for this purpose unsatisfactory.

2. Patients whose activities are considerably limited by their cardiac condition in the early months of pregnancy, or before the 28th week, should have their pregnancy terminated without delay. They should be, at the same time, sterilized.

3. Patients for the first time seen after the 28th week should be treated conservatively and allowed to deliver themselves spontaneously. Sterilization should be performed after the puerperium. Surgical interference on account of cardiac disease alone (e.g. Caesarean Section or surgical induction of labour) is contra-indicated.

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A P P E N D I X.

I have considered that it would be of little interest or value to append complete histories and case notes of the entire series which have been investigated. Only a few cases typical of the class they represent will be described in detail. These, it is hoped, will give a general impression of the variety of cases met with in the investigation and already alluded to statistically in the text.

As an example of the primigravida in Class I the following history is submitted:-

Mrs. McI. Age 20, was recommended for admission by her doctor on account of cardiac disease complicating pregnancy. As a child she had had three attacks of rheumatic fever and had been treated in hospital. On examination she was found to be four months pregnant. She had mitral incompetence. The left border of cardiac dulness was 4½ inches from midsternum and there was a loud apical systolic murmur. The lungs were clear. There was no evidence of commencing heart failure. The patient felt extremely well. She could perform simple tests e.g. running up a flight of stairs, without undue symptoms of dyspnoea or marked rise in pulse rate. She was treated as an out-patient and reported at monthly intervals. At no time during her pregnancy was she distressed. Her delivery was spontaneous at term after a labour lasting approximately eleven hours. The puerperium was normal. An electrocardiogram taken at the fourth month is shewn.

This patient was classed as Group I upon the functional capacity of her heart. This functional capacity was so satisfactory that it enabled the physician in charge to ignore her valvular lesion and rheumatic history so far as her pregnancy was concerned.

As an example of the multipara in the same class (Group I) I have selected the following case:-

Mrs. H. age 37, 2nd pregnancy. Three years before her first confinement patient contracted rheumatic fever. During her first pregnancy patient had not been distressed. Her first labour terminated in a forceps delivery after a twelve hour labour which did not cause her undue discomfort. Her general condition remained satisfactory after this confinement. A year and ten months later patient fell pregnant for second time (present pregnancy). She was sent into hospital by her private doctor a fortnight before term as a case of cardiac disease complicating pregnancy. Throughout this pregnancy she had felt "much as usual". There were no physical signs of loss of cardiac reserve. There was a presystolic murmur at the apex and the second cardiac sound was accentuated at the pulmonic area. The lungs were clear and there was no oedema of feet. The pulse rate was 90/ minute. After exercise tests her pulse rate increased to 110/ minute but fell to 90/ minute in 15 seconds.

She was treated by rest in bed only and a fortnight after admission went into labour and delivered herself spontaneously of an 8 lb. infant in seven hours. Neither in labour nor in the puerperium were there signs of cardiac embarrassment.

To represent Class IIA two cases will be outlined, one a primigravida and one a multipara:-

Mrs. C. age 28, primigravida, admitted at the 8th month from the antenatal clinic on account of cardiac disease complicating pregnancy. In childhood patient contracted severe scarlatina which was said to have affected her heart. There was always slight dyspnoea on exertion (in the non-pregnant state). For the first six months of her pregnancy she was able to carry on her household duties without difficulty. At the sixth month (November) she contracted bronchitis. This cleared up considerably but her dyspnoea increased and she was forced to rest more often. On admission to hospital she was dyspnoeic on exertion. Pulse rate 110/ minute. Blood pressure 120/80 m.m. There was a rough presystolic murmur at the apex which was not conducted. The heart was not enlarged. There were a few subcrepitant rales at the bases of the lungs which persisted on deep breathing. (These disappeared after a week's rest in bed). She was treated by rest alone. Her condition improved markedly and she could perform simple exercises without more than a little dyspnoea. After six weeks in hospital resting she went into labour. The position proved to be an occipito-posterior. After eight hours in labour she was delivered of a 6½ lbs. infant by low forceps. Shortly before delivery there were some signs of distress, notably cyanosis with the pains. Her condition after delivery was eminently satisfactory and the puerperium was normal. The infant was bottle-fed.

The next case to be described is a multipara in the same Class (IIA).

Mrs. R. age 28, 5th pregnancy, was admitted to hospital from the Antenatal Clinic on account of the cardiac condition when eight months pregnant. In childhood she had had chorea. Her first two pregnancies caused her no inconvenience. Thereafter she contracted rheumatic fever. A year after this attack of rheumatic fever she became pregnant and from the 3rd month had some degree of cardiac embarrassment. She delivered herself, however, spontaneously at term in her own home. Two years later she had her fourth pregnancy and again found her activities somewhat limited from the early months onwards. Again she delivered herself spontaneously at term. She breast fed all her infants. Three years later she became pregnant for the fifth time (the pregnancy under review). At two months she was admitted to another hospital on account of her history and some praecordial pain. After three weeks she was dismissed. She continued her pregnancy resting as much as her domestic duties permitted.

When she was admitted to the Glasgow Royal Maternity Hospital at the eighth month her activities were only slightly limited. She was rather dysnoeic on exertion but there was no oedema and she slept well in a prone position. The heart was enlarged one inch to right of midsternum and five inches to left of midsternum. There was a presystolic thrill and murmur at the apex. There were a few fine crepitations at the bases. Her condition remained unchanged and she gave birth spontaneously to a premature infant (3 lbs. weight) after a labour of eight hours.

In a case of this type where the cardiac reserve was apparently fairly good Caesarean Section and sterilization might have been justifiable on the grounds of prevention of future pregnancies;

Class IIB is the group in which there is considerable limitation of activity. It contains that type of patient regarding the treatment of which the greatest controversy exists. The views put forward in the text of the thesis support the conservative form of treatment in the later months and the radical treatment in the early months. I will quote in detail four cases in this group which lend support to the figures and contentions of the thesis. These cases are quoted only as an illustration of the statistics which have been already put forward.

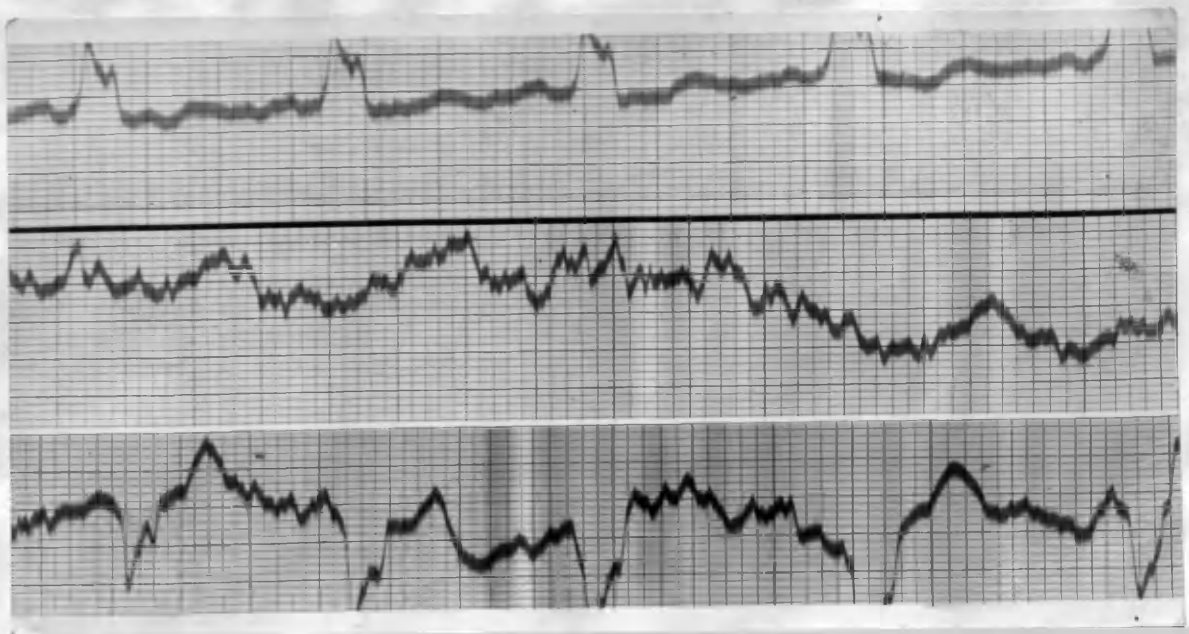
The first case is that of a primigravida with severe cardiac disablement early in pregnancy. Her treatment was carried out in what I have suggested is the correct mode of procedure in this type of case:-

Mrs. K. age 27, 1st Pregnancy, Patient had two severe attacks of chorea in childhood; at the age of 17 and 21 respectively she had attacks of rheumatic fever, all necessitating hospital treatment. In the non-pregnant state she had occasional dyspnoea and oedema of feet and ankles. On marriage she became pregnant and was admitted to hospital at the 3rd month. There was dyspnoea on exertion. There were slight choreiform movements of arms and legs. The lungs were clear and the liver was not enlarged. Pulse was regular and ran between 95 and 100/ minute. The heart was enlarged to right and to left. There was a presystolic murmur at apex and a diastolic at base. B.P. was 120/70. She was confined to bed for four weeks, glucose and small doses of digitalis were administered. As her condition did not improve the pregnancy was terminated by abdominal hysterotomy under nitrous oxide and oxygen anaesthesia. She was sterilized at the same time.

Convalescence was disturbed by an attack of post-operative pyelitis and from 10th to 16th day patient's heart appeared to be seriously embarrassed. She was dismissed 24 days after operation. At a "follow-up" six months later her condition was similar to what it had been before her pregnancy. The electrocardiogram was taken at the fourth month but did not amplify the clinical picture.

The second case was also a primigravida but who refused treatment. Her case shows how, despite a serious cardiac lesion, a patient may weather a normal pregnancy. (The late results, however, do not justify the risk).

Miss M. Age 27, 1st pregnancy. Patient had chorea and two attacks of rheumatic fever, all necessitating hospital treatment. Admitted to hospital when four months pregnant. She had been confined to bed at home for six weeks prior to admission. There was marked dyspnoea on exertion. No oedema present. She complained of severe palpitations. The pulse was regular 80-90/minute but "water-hammer" in type. The area of cardiac dulness extended five inches to left and half an inch to right of midsternum. There was a definite aortic systolic and diastolic murmur also a systolic apical murmur. The quality of the sounds was poor. An electrocardiogram showed right bundle branch block (see below). After a fortnight's rest patient refused treatment and left hospital irregularly. She was visited in her home periodically throughout her pregnancy. Although her activities were limited she was never confined to bed. There was oedema at the 7th month. She was readmitted to hospital when she had been in labour for some time and was delivered by low forceps of a 5¼ lb. premature infant. During her labour (which was cut short in hospital) she was definitely distressed. The puerperium was uneventful. When examined several months later her cardiac condition seemed much about the same. No improvement nor degeneration could be detected. Unfortunately she would not submit to further electrocardiographic investigation.



The next two cases are examples of multipara who first sought advice late in pregnancy. They were both admitted to hospital about the same time and both were selected for Caesarean Section at term (the radical type of treatment). Both cases were carefully watched and their case histories provide an interesting comparison. The first patient to be described had a precipitate labour before Caesarean Section could be performed and serves as an example of conservative treatment:-

Mrs. K. Age 32, 7th pregnancy. Admitted when 7½ months pregnant. No definite rheumatic history. Previous pregnancies had not caused much cardiac distress. At five months patient had extreme dyspnoea on exertion and oedema of feet and ankles. On admission she was orthopneic. The heart was enlarged. The liver was slightly enlarged. There was slight oedema of bases of lungs. Presystolic murmur at apex and reduplication of 2nd sound at pulmonic area. The urinary output was good. Patient was treated with rest and digitalis (ten minims t.i.d.) for nine weeks. When she went into labour she was prepared for Caesarean Section but delivered herself spontaneously before the operation could be performed. The puerperium was uncomplicated.

At a "follow-up" twelve months later the patient was found to be seriously ill. Her cardiac condition necessitating her removal to a general hospital.

This case shows that from the obstetric view point her pregnancy and confinement were safely conducted by conservative means. From a cardiological and general view point her pregnancy caused serious damage to an already damaged heart:-

Mrs. B. Age 33, 6th pregnancy. Admitted when eight months pregnant. History of rheumatic fever (one attack) in childhood. Her first four pregnancies had caused no distress but during her fifth pregnancy.

She had had dyspnoea from the seventh month. Her previous confinement was normal and spontaneous. Her present pregnancy (three years later) first caused cardiac distress at the 6th month when she had dyspnoea and limitation of activity. She had also a severe cough and one attack of haemoptysis. On admission she was orthopneic. The heart was enlarged. Liver was not enlarged. There were crepitations at the bases of the lungs. There was a presystolic murmur at the apex and accentuation of the 2nd sound at the base. There was oedema of feet and ankles. Patient was treated with rest alone for four weeks. One hour after the onset of labour a classical Caesarean Section was performed and sterilization carried out, under gas and oxygen anaesthesia. Patient died of cardiac failure with terminal pulmonary oedema fourteen hours after operation.

At post mortem there was marked hypostatic oedema of lungs. The heart weighed 1 lb. 7 ozs. There was marked mitral stenosis and vegetative endocarditis.

The above case was treated on the radical obstetric principle and is an example of the unsuccessful result which may follow this line of procedure. It must be clearly understood, however, that the writer does not submit these cases as proof of his contentions, they are merely illustrations of the statistics quoted in the text.

As an example of the Group III Class of patient one case will be quoted. The patient showed complete cardiac breakdown associated with pregnancy and, from the obstetric view point particularly, was treated with an eminently satisfactory result:-

Mrs. I. Age 38, 5th pregnancy. Admitted at term. Vague rheumatic history. Her first three pregnancies were normal but at her fourth pregnancy she suffered from cardiac embarrassment from the 6th month onwards. Four weeks after the birth of this child she was admitted to the medical wards of a general hospital where she remained for nine weeks on account of her cardiac condition.

During the four years which intervened between her fourth pregnancy and the present one she found her activities considerably limited. From the first month of her present pregnancy she had distress. She took to her bed at the second month.

On admission she was orthopneic and in great distress. She had marked generalised oedema. The heart was markedly enlarged. The liver was enlarged. There were crepitations at the bases of the lungs. The pulse rate was over 160/ minute and very irregular. There was auricular fibrillation. The patient was given half drachm doses of the tincture of digitalis two-hourly until she had had two drachms. The dosage was reduced to fifteen minims two-hourly until the total dosage does was three and a half drachms. Her pulse rate then steadied and ran at 140/ minute but fibrillation continued. Thirty-six hours after admission labour commended. She was treated with morphia and pituitrin. The labour lasted 2½ hours and was spontaneous (still born child 6 lbs. weight. After labour she continued to have cardiac embarrassment. Digitalis was administered in doses of 15 minims four-hourly until the pulse rate fell to 80/ minute. This occurred three weeks after labour. The patient was electrocardiographed. She was dismissed in a greatly improved condition five weeks after her admission (pulse rate on dismissal 100/ minute still irregular).

When seen a year later she still suffered from auricular fibrillation but was able to carry out light domestic duties without undue discomfort.